THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

[Registered as a Newspaper.]

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GAS PURIFICATION
BY
OXIDE OF IRON.

COOKE BROS.,
CENTRAL DEPÔTS:
CO. DONEGAL, IRELAND;
LONDON DEPÔT:
BLACKWALL, E.;
OFFICES:
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GENUINE TORBAY PAINT
And SPECIAL GASOMETER PAINT.
Several Prize Medals. Established over 20 Years.
These Paints are now used in over 200 Country Gas-Works, and by all the London Gas Companies, on Gas-holders, Scrubbers, Purifiers, &c. Also used by the Admiralty, War Office, Railway Companies, Founders, &c. They prevent and arrest rust, and protect iron from the action of water, sulphurous and gaseous exhalations; do not crack, blister, or flake off; will cover tar effectually.
The covering powers are considerably greater than those of any other Paint.—*See "Engineer," Nov. 2, 1866.*
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TORBAY PAINT COMPANY.
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Gas, Water, & Sanitary Purposes,
AND MANUFACTURER OF
WOOD GRIDS
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COWEN'S PATENT FIRE-CLAY RETORTS.
JOSEPH COWEN and CO.,
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J. C. and Co. have been for many years the most extensive Manufacturers of Fire-Clay Retorts and Fire-Bricks in the Kingdom. Orders for Fire-Clay Retorts of all shapes and dimensions, and to fit any shaped Mouthpiece, Fire-Bricks, and every other article in Fire-Clay, are promptly executed at their Works as above.
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WET AND DRY GAS-METERS,
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PATENT COMPENSATING METERS,
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Established 1820.

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CAST & WROUGHT IRON TANKS FOR DITTO,
And Gas Apparatus of every Description.
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Sugar, Saltpetre, and all kinds of Pans.
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JAMES E. & SAMUEL SPENCER, Agents.

THE
"OTTO" GAS-ENGINE.
See Page 746.
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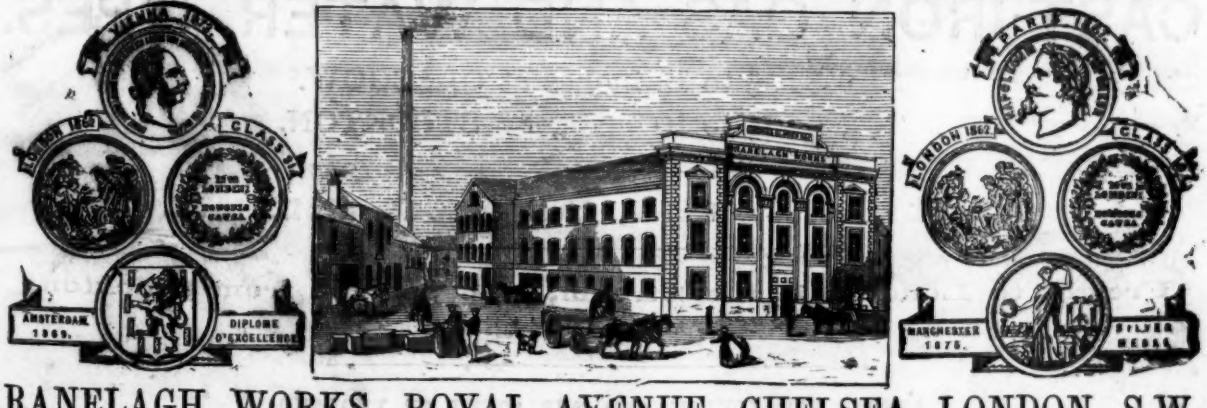
DRY GAS-METER MANUFACTURERS.
HAVE REMOVED TO MORE EXTENSIVE PREMISES:



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IN CAST-IRON CASES,

THE UNVARYING WATER-LINE GAS-METER,

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IMPROVED DRY GAS-METERS;

STATION-METERS OF ALL SIZES, with PLANED JOINTS;

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CAST-IRON GAS AND WATER PIPES.

SIZES: ¾ to 12 inches at GLASGOW.

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Freight to London, in the Stream, 10s. per ton from Stockton; 15s. from Glasgow.

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IMPROVED HYDRAULIC CRANES,

Effecting a great saving in the cost of discharging Coals from Vessels, Barges, &c. Several of these Cranes, with the necessary power, are now being erected at the Beckton Gas-Works.

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HYDRAULIC APPARATUS for Lifting and Lowering Purifier-Covers.

Sixteen recently erected at Beckton, applied to Covers 30 feet square.

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IN SUCCESSFUL OPERATION AT THE NEW WORKS OF THE NEWCASTLE AND GATESHEAD GAS COMPANY.

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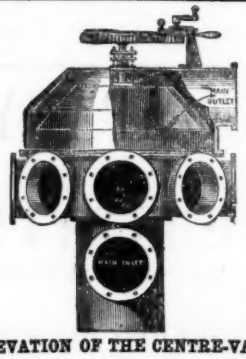
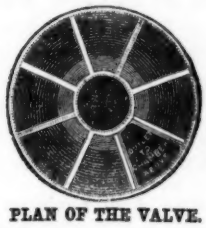
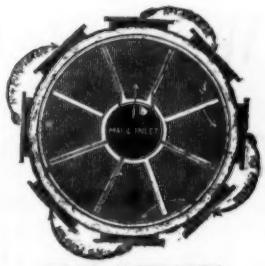
C. & W. WALKERS'
PATENT CENTRE-VALVES.



ELEVATION OF THE CENTRE-VALVE.



PLAN OF THE VALVE.



PLAN OF THE BODY.

These PATENT CENTRE-VALVES are the most perfect and certain means for working Purifiers on the system of three in action, and one out of action. The Valve itself is protected from all injury inside the safety cover. The working of the Valve is so easy, and so governed by the stop-catch movement, that the Purifiers can be instantaneously changed in the dark as well as in daylight. They are scraped perfectly true, metal to metal, the facings heretofore exposed are always covered, and there is nothing more reliable, certain, and durable in a gas-works. By their use the floor of the Purifying-house is clear and level; the Valve and all connexions being beneath the floor, out of the way of working. A considerable improvement and saving is effected in the cost of the connecting-pipes.

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An extensive variety of Choice Designs in CHANDELIERS, PENDANTS, BRACKETS, STAR and SUN LIGHTS, MEDIÆVAL FITTINGS for CHURCHES, &c.

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And every description of Gas Machinery.

TENDERS GIVEN FOR WORK FIXED COMPLETE IN ANY PART OF THE KINGDOM.

WEST'S GAS IMPROVEMENT COMPANY,

LIMITED,

ARE NOW PREPARED TO SUPPLY AND ERECT THEIR PATENTED MACHINERY FOR

CHARGING AND DRAWING GAS-RETORTS,

And to enter into arrangements with GAS COMPANIES for its use upon moderate terms of Royalty.

The Patented Machinery has secured the approbation of all Engineers who have visited the MAIDSTONE GAS-WORKS, *where it is in full operation, and may be inspected at any time on application to the Manager.*

The advantages attending its use are—

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FOR PURIFIERS, GASHOLDERS, BYE-PASS, AND OTHER ARRANGEMENTS REQUIRING VALVES IN GAS-WORKS.

The Faced Valves, as made by the Patentees, continue to give great satisfaction, and they are being used extensively by many of the best gas engineers of the day.

They are more easily repaired than any other kind of Valve in use, and can be re-ground in a few hours without removal, and made perfectly gas-tight.

References can be given to many Engineers of high standing, who will testify as to the favour in which they are held.

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LAMP-METERS IN CAST-IRON BOXES,

And every Description of Gas Apparatus.

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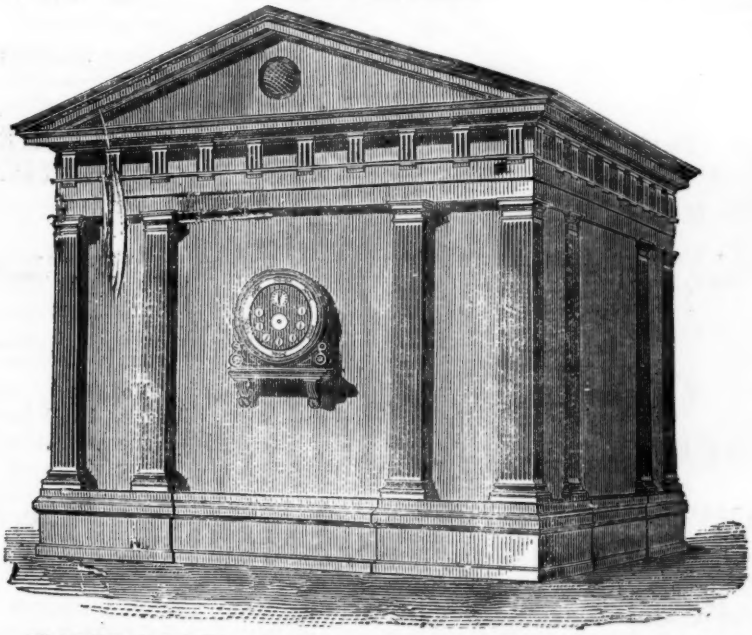
OF THE HIGHEST EXCELLENCE ONLY;

ALSO LICENSEES AND MANUFACTURERS OF

WARNER & COWAN'S PATENT SELF-REGULATING GAS-METERS;

ROUND STATION-METERS,

ON CAST-IRON STANDS.



SQUARE STATION-METERS,

WITH PLANED JOINTS.

GOVERNORS, GAUGES, INDICATORS, MAIN COCKS, &c.

GAS COOKING APPARATUS.

Home and Foreign Orders promptly attended to.

All Sizes of **CONSUMERS METERS, STATION-METERS, and GOVERNORS** generally in Stock.

Orders almost invariably despatched on the day of receipt.

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WOOD PURIFIER SIEVES,

Which have now been used for fifteen years, and their advantages and durability fully established. They are made entirely by steam machinery in very large quantities at the most moderate cost.

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ESTABLISHED IN 1860.

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BLAST-FURNACE, TANK BRICKS, LUMPS, TILES,
And Every Description of Best Fire-Bricks.

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Plans and Estimates furnished; Gas-Works, Apparatus, Pipes, Machinery, Fire Goods, &c., supplied, or Attested and Shipped for Exportation.

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MR. ROMANS has for upwards of 30 years been practically engaged in the Manufacture of Gas, and has, by extensive experiments, ascertained that by JUDICIOUS INTERMIXTURE of the lighter with the heavier gases, much of the rich Hydrocarbons CAN BE SAVED, which otherwise ARE LOST, during the process of manufacture. He is therefore enabled to give advice to those who favour him with their orders for Cannel, as to the class which will secure for their standard of illuminating power the HIGHEST ADVANTAGEOUS RESULTS.

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PORTABLE PIPE SCREWING MACHINE,

For 1 in., 1¼ in., 1½ in., and 2 in. Gas Threads, complete £7 10s.

In use at the chief gas-works, and giving great satisfaction.

For other useful goods, see Bailey's "Illustrated Inventions," post free 3s. 6d.; gratis to ledger customers.

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Brassfounders, Gauge Injector and Tool Makers,

ALBION WORKS, SALFORD,

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Gold Medal Awarded, Paris Exhibition, 1878.

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SHEAF AND SPRING WORKS,

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MANUFACTURERS OF

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FOR ENGINEERS,

STEEL OF ALL DESCRIPTIONS,

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The only Gold Medal awarded for "Apparatus and Processes for Heating and Lighting" by the Imperial Commissioners

MEDAL FOR PROGRESS, VIENNA, 1873.

The following Medals were also awarded at Paris, 1878:—

GOLD MEDAL for Chandeliers and Gas-Fittings.

GOLD MEDAL (Rappel) for Metallic Bedsteads and Furniture.

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ROLLED METALS, LOCOMOTIVE AND CONDENSER TUBES, CYLINDERS;

Ornamental, Taper, and Cased Tubes; Tin Tubes;

GAS-FITTINGS, CHANDELIERS,

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METALLIC BEDSTEADS.

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REGISTERED TRADE MARK:

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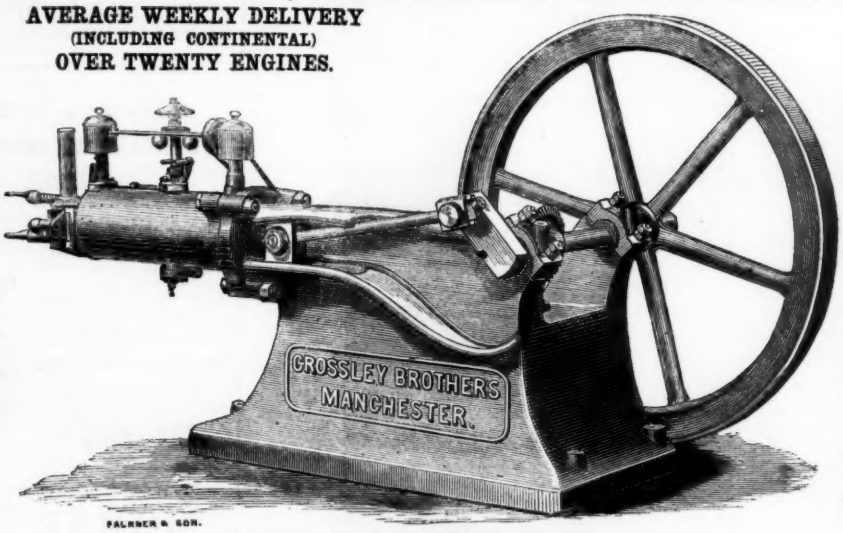
AN ENGINE WHICH WORKS WITHOUT A BOILER OR STEAM

AVERAGE WEEKLY DELIVERY
(INCLUDING CONTINENTAL)
OVER TWENTY ENGINES.

The durability of these Engines is now established by experience, one of them having run night and day at the Hinckley Gas-Works for over Twelve months without any expenditure for repair; this being equal to about 2½ years average work.



Over 1900 already delivered.

Very numerous Testimonials from Users, including Engineers, Men of Science, and others, on application to the makers.

No trouble with Coal, Ashes, Smoke, Insurance, Water, or constant attendance.

No Glands to pack, or Water Gauges and Steam Gauges to watch.

STARTS AT A MOMENT'S NOTICE.

THE "OTTO" SILENT GAS-ENGINE.

(Otto and Crossley's Patents, 1876 and 1877,)

THEY ARE USED FOR ALL KINDS OF PURPOSES, CHIEFLY FOR EXHAUSTERS, SCRUBBERS, & PUMPS.

DELIVERED IN MANCHESTER.	SIZES									OFFERED.	CASES NOT CHARGED IF RETURNED FREE
	NOMINAL HORSE POWER	½	1	2	3½	6	8	12	16		
	MAXIMUM HORSE POWER	¾	1½	2½	4	9	12	18	24		

PRICES INCLUDE CAST-IRON STAND, TURNED FLY-WHEEL, AND DRIVING PULLEY; WATER-VESSEL, SEVERAL DUPLICATES, AND GAS-FITTINGS (EXCEPTING METER AND PIPES).

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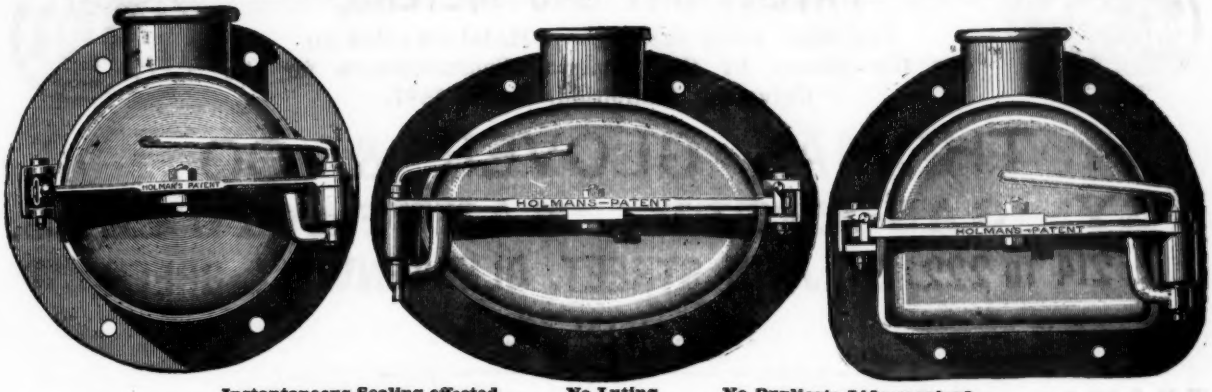
CORNWALL HOUSE, 35, QUEEN VICTORIA STREET, LONDON, E.C.,

(LATE OF 10, LAURENCE POUNTNEY LANE.)

SOLE MAKERS OF MORTON'S PATENT SELF-SEALING RETORT-LIDS,

WITH HOLMAN'S PATENT ECCENTRIC FASTENINGS,

Anti-Friction Catches, and New Self-Adjusting Cross-Bars.



Instantaneous Sealing effected. No Luting. No Duplicate Lids required.

Holman's New Self-Sustaining Cross-Bar ensures freedom of Joint, and maintains parallel position of the Lids.

Since their introduction in 1869, these Patent Retort-Lids have been thoroughly itested, being now in use in nearly all the principal Gas-Works in London and the Provnces.

T. B. and H. are now making the "Morton's Self-Sealing Lid" of the SAME FORM OR SECTION AS THE RETORT (see Illustrations above), as well as bringing the Mouthpiece from the D or Oval at back to Circular in front, as heretofore.

D and Oval Morton's Lids are working satisfactorily both in this country, on the Continent, and in the United States of America. Among others they have been adopted by the following Gas-Works:—

The Gaslight Company's Works, Fulham; Ditto, Bromley-by-Bow; Ditto, King's Cross; Ditto, Shoreditch.
And also in the Gas-Works at Richmond, Maidstone, Gloucester, Glasgow, Portsea, Roubaix (France), The Hague (Holland

HUNT'S PATENT EQUILIBRIUM GAS-GOVERNOR.

In this Governor a Throttle-Valve is substituted for the ordinary suspended Cone, all external communications being avoided by placing the Lever or Radius Arm (shown in the drawing) inside the Valve-Chamber upon the Disc. The Disc is carried upon steel centres, upon which it is accurately balanced and turns freely. The friction in working is thereby reduced to a minimum. This Governor is extremely sensitive to alterations of inlet or outlet pressure, and renders a large actuating holder unnecessary.

The principal advantages of this arrangement over the ordinary form of Governor are as follows:—

Its sensitive action prevents oscillation.

It is self-adjusting—*i.e.*, it maintains a steady pressure under variations of inlet pressure or a fluctuating consumption.

The inlet to Gasholder being contracted to the smallest possible dimensions, all danger from leakage through insufficiency of seal, tilting, &c., is entirely avoided.

The valve portion being separate from the holder, it can be handled and fixed like an ordinary Slide-Valve direct in the main; and the holder can be placed at an convenient distance immediately above it. The cost is thus materially reduced, and the inconvenience of heavy lifts done away with.

There are no working parts likely to get out of order.

These Governors have been adopted by many leading Gas Companies, among whom are the following:—

The Gaslight and Coke Co. (9), The London Gas Co. (3), and at Abergavenny, Arundel, Birmingham, Cannes (France), Devonport, Dursley, Exeter, Guernsey, Halesowen, Mentone (France), Monmouth, Newcastle-on-Tyne, Oxford, Plymouth, Rochdale, Windsor, &c.

TESTIMONIAL.

The Gaslight and Coke Company,
9, Water Street, New Bridge Street,
Blackfriars, E.C., Feb. 27, 1875.

MESSRS. TANGYE BROTHERS AND HOLMAN.

Gentlemen,—The two 24-inch and three 36-inch Hunt's Equilibrium Governors supplied by you, and fixed in the valve-rooms at Whitechapel, Goswell Road, and Blackfriars, are working very satisfactorily.

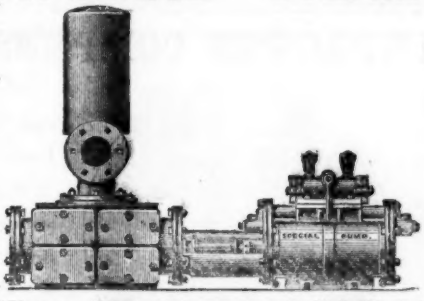
Yours truly,

(Signed) JOHN JOHNSON.

PRICES AND FULL PARTICULARS ON APPLICATION.

THE "SPECIAL" STEAM-PUMP.

Diameter of Steam Cylinder.	Diameter of Water Cylinder.	Length of Stroke.	Gallons of Water per Hour, Approximate.	Reduced Prices.
3	1½	9	450	£16
4	2	9	815	18
5*	2½	12	1,250*	20
5*	3	12	1,830*	22 10
4	4	12	3,250	25
6*	4	12	3,250*	30
5	5	12	5,070	32 10
7*	5	12	5,070*	40
6	6	12	7,330	40
8*	6	12	7,330*	50
7	7	12	9,750	50
10*	7	12	9,750*	65



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6th, Prevent jumping or unexpected extinction of the Lights;
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Are upheld for five years without charge.

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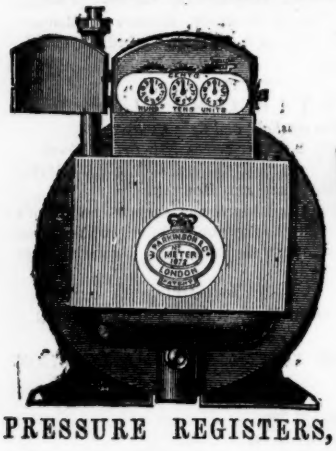

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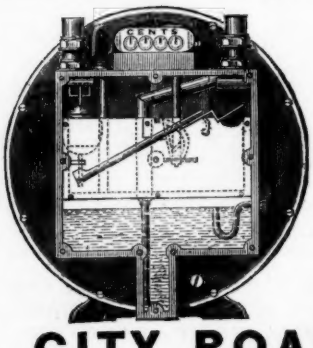

The Meter has been critically tested, and most favourably reported upon by official Meter Inspectors in London and Birmingham.

W. PARKINSON and CO. have made arrangements for the manufacture of these Meters, both in tin and cast-iron cases, and for the alteration of old ones to this principle, which is confidently recommended as possessing every quality that can be desired by Gas Companies, Corporations, or Private Consumers.

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TO CORRESPONDENTS.

Owing to unusual pressure on our space to-day, the report of proceedings at the last meeting of the Midland Association of Gas Managers, promised for this week, is obliged to be held over.

M. O.—*The experiment was noted in the* JOURNAL *of the 6th inst. We are obtaining further information as to the form, and the result of using the burners.*

A. W. M., "Discounts on Gas Accounts;" LUX, "The Registration of Gas-Meters"—*too late for this week.*

We would again remind correspondents that, to ensure insertion in the next number of the JOURNAL, *letters should reach the Office by Saturday at latest.*

No notice can be taken of anonymous communications. Whatever is intended for insertion, must be authenticated by the name and address of the writer; not necessarily for publication, but as a guarantee of good faith.

THE JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, MAY 20, 1879.

Circular to Gas Companies.

THE Committee on the electric light, of course, continue their sittings. To say the truth, very little turns up which is of special interest to Gas Companies, or really bears on the question referred to the Committee. The reference was for them to consider under what circumstances "it is desirable to "authorize Municipal Corporations, or other Local Authorities, "to adopt any schemes for lighting by electricity, and to consider "how far and under what conditions, if at all, Gas or other "Public Companies should be authorized to supply light by elec-"tricity." No evidence affecting this reference has been offered; no suggestions of any necessity for legislative interference with the supply of the electric light, other than those we mentioned last week, have yet been put forward. It is given in evidence that cables conveying electricity for light must be kept far apart from telegraphic wires, and it is also in evidence that Electric Light Companies can make large profits. Here we have ground for the interference of legislation; but these are the only two reasons shown for such interference. To-day, we shall have the evidence of Sir J. M'Garel Hogg and Mr. Farrer, the latter of whom will, of course, give us the views of the Board of Trade on the subject. Here the question will begin to get interesting. Hitherto the mere description of the various systems of electric lighting, the photometrical results, and all that, have possessed but little interest to those who have followed the question through all its phases. The photometrical value of the electric light, as compared with gas, is not easily ascertainable, and we place very little reliance on what has been said on the matter. What we know is, and what is placed beyond a doubt is that gas burnt in sufficient quantity can fairly compete with electricity, and, indeed, beat it out of the field. The report of the Engineer and Chemist to the Metropolitan Board of Works, relative to the experiments on the Thames Embankment, shows conclusively that electricity employed for lighting purposes is dearer than gas. It is stated, in the report of the two gentlemen we have mentioned, that the cost of the electric light is 5·73d. per hour, and that for gas equivalent to the electric light in an opal globe is 2·00d. per hour, and in a frosted globe 3·50d. per hour. Hence, on the score of economy, nothing can be expected to result from its adoption for public lamps.

To return, however, to the necessity for legislative measures, we may remark that, whatever may be said by the eminent witnesses who will be examined to-day, nothing has been shown up to the present time which could possibly militate against the supplying of the electric light by Municipal Corporations and Gas Companies, supposing that the light was ever to be made a useful institution. We have always regarded the withdrawal of the Bills promoted by Corporations and Companies as rather disastrous to their interests. It was, however, rendered advisable by the action of external influences. It is quite clear now that no legislative interference will be necessary with regard to the electric light, further than what we have referred to above. Mr. Farrer may possibly have his particular views, but we are certain that they cannot differ from our own. Limit the profits of the Electric Light Companies, and protect the Post-master-General, and everything is accomplished.

The improved gas lights in Waterloo Place have been removed earlier than we expected, by request of the Vestry. Comparisons, as Mrs. Malaprop observes, are "odorous," and probably the Vestry of St. James's did not like to see the brilliant light in proximity to the dull glimmer they ordinarily furnish. We have repeatedly said that Vestries will not pay for good illumination. They are not bound to gas, which affords them the best light they can get; but whatever system of lighting may be recommended, it is certain that it will not be adopted if it involve any additional expense. We cannot say that the parish of St. James is the worst lighted in the Metropolis, but the illumination certainly might be improved, and we are sure that the respectable inhabitants of the district would willingly pay their quota towards the cost of the additional light. The Gas Company, of course, do not deplore the decision of the Vestry, for they supplied the gas gratis, and Mr. Sugg is not incommoded, seeing that he quickly disposed of all his lamps. The action of the Vestry is, at all events, reprehensible, and it leaves us with little hope that any great improvement can be effected in the public lighting in the Metropolis.

Parliament progresses fairly well with the Gas Bills. The Glossop Bill has passed the Lords with certain important alterations. The initial price was reduced to 5s. per thousand, and the proposed capital was cut down to £30,000, instead of £40,000 proposed in the Bill. The quality of the gas is to be fifteen candles, against eighteen, which, we believe, the Company have hitherto been supplying. We regard this as rather a hard case. The Glossop Company have done their best, under rather difficult circumstances. The nature of the ground in which their mains are laid causes a large amount of leakage, for which the Company are not really responsible. They ought, then, to have had a higher initial price. As regards the capital they asked for, it should be remembered that it is not to the advantage either of Gas Companies or consumers to make frequent applications to Parliament, the cost of which must eventually be paid by the consumers. Once in twelve years is often enough for a Gas Company to go to Parliament, and the capital asked for would have been only sufficient to carry them on for that period.

The Crystal Palace District Gas Company's Bill passed the Commons Committee entirely unopposed. This is a great satisfaction, as the Act will confer powers which have been objected to in some other cases.

The Aire and Calder Navigation Company have carried their Bill, which is to enable them to raise further capital for the supply of gas to Goole and the neighbourhood. The works were originally started with profits realized by the Navigation Company, and the new capital will be raised from the same source. For this reason, auction clauses and sliding scale are not imposed. The profits are limited to five per cent.

The Plymouth and Stonehouse Gas Company's Bill has also passed a Committee of the Commons, but the initial price was—we think very unfairly—cut down to 2s. 6d. per thousand feet. This excellently well-managed Company deserve better treatment at the hands of the Corporation. They supply gas of

first-rate quality, at a price nearly the lowest in the kingdom, which results from the fact that the Company have so well husbanded their resources that their capital is exceedingly small in relation to the size of the undertaking. It was endeavoured to force the supply of sixteen-candle gas upon them; but the Committee decided that the quality should remain as fixed in the Bill—fourteen candles.

In the case of the Morecambe Gas Bill and the Wisbech Gas Bill, all differences having been arranged, the Bills went forward without opposition.

We announced a few weeks ago that the Corporation of Middlesbrough had compelled their Gas Manager to resign his post. The matter is of little consequence to him, inasmuch as he obtained immediate occupation elsewhere. Subsequently the Gas Committee of the Corporation advertised for a successor, and received the extraordinary number of seventy-nine applications for the appointment. The Committee had resolved that they would not pay more than £200 a year—a very insufficient remuneration, to our minds, for the management of an undertaking of the importance of that at Middlesbrough. But they were presently taken with a further fit of economy, and resolved that they would pay nothing at all. They, in fact, directed the Borough Surveyor to undertake the duties of Gas Manager, without any addition to his salary. The poor man was ill in bed when he received the news of the unprofitable honour conferred upon him, but he accepted the appointment, and expressed a hope that within a few weeks he would be master of the art of gas-making. We shall not attempt to discourage him. Gas-works under the superintendence of an efficient foreman go on with much regularity, but every now and then difficulties arise which only a skilful engineer can cope with, and possibly within a short time the Corporation of Middlesbrough may find that their parsimony has brought them into a mess. The tank and new gasholder will be quite sufficient to occupy the attention of a thorough engineer for some time to come; and presently, when trade revives and extensions are required, the services of a practical manager will be of prime necessity.

There is a dispute between the Town Council of Ipswich and the Gas Company, as to the supply of the public lamps. Of course, the former wish the public lights to be supplied at an unremunerative rate, to which the Company decidedly object. Hitherto, the lamps have been charged for on the supposition that each one consumed three and a half feet per hour, but in numerous instances this consumption was largely exceeded. The Company now make an offer to supply the lamps on the average meter system, and to provide the meters at their own expense. The proposal seems to find some favour in the Council, and we would strongly recommend them to fall in with it at once. If they inquire, as they propose to do, what is the experience of other towns who have adopted the system, they will find that it has given universal satisfaction. It satisfies the minds of the ratepayers that they are furnished with what they pay for, and contents the Gas Company, who know exactly what they distribute.

We are glad to find that the question of the revivification of lime was introduced at the meeting of the West of Scotland Association of Gas Managers. It is a matter in which we have taken considerable interest for years, being certain that, under the circumstances in which many Gas Companies are placed, great economy would be effected, and much nuisance avoided. It is highly satisfactory to see that Mr. Hislop has brought his process to "perfection." If so, we have no doubt it will be largely adopted.

The Southern District Association of Gas Engineers and Managers have recently held a very interesting meeting at Maidstone, when Mr. Hammond, of Lewes, read a valuable paper on the purification of gas by his patent process with the use of ammoniacal liquor. We have constantly advocated the purification of gas in closed vessels, and are happy to find that Mr. Hammond's practice continues to show that this may be accomplished with efficiency and economy. For the rest, the members were greatly interested in the visit to the Maidstone Gas-Works, where they witnessed West's system of charging and discharging retorts by machinery. This simple and really beautiful invention is, we are glad to see, coming more and more into favour. The Gas Committee of the Corporation of Manchester recently paid a visit to the Maidstone works, and were so pleased with the invention that they have recommended its adoption in the gas-works of their Corporation. This is a high tribute to the inventive genius of Mr. West. It is to the credit of the Maidstone Gas Company that they have been prompt in adopting all recent improvements. They have now in use White's patent automatic valve, which supersedes the dip-pipe; and Mr. G. Livesey's patent scrubber-washer, which, no doubt, tends to improve the quality of the gas. The thing, however, may be overdone. We have been told of a ship which proceeded to sea with thirty-six patent inventions included in its construction. The ship went to the bottom, but we cannot say that any one of the inventions had anything to do with the catastrophe.

On the eve of the meeting of the British Association of Gas Managers, we receive strong recommendations to plead the cause of Gas Managers with Corporations and Gas Companies, who have the strongest interest in affording their officers every opportunity to acquire knowledge which will eventually be serviceable to their employers and the public. We second these recommendations very willingly, and hope that Corporations and Companies will freely grant leave of absence for the attendance of their Managers, and at the same time give a gratuity in aid of their expenses. The money will be well laid out, and in time is certain to produce its results in benefits to the undertakings which the Managers superintend.

We are happy to find that the strike of the Durham coal miners is at an end, and that work has been resumed in real earnest at all the pits. Gas coal is now freely shipped to all ports at home and abroad, and there is no fear of any interruption to our industry.

Mr. Shoolbred has expanded the pamphlet on electric lighting,* which he published some time ago, into a neat little volume. We need hardly inform our readers that the author is an intense admirer of the electric light, and holds to the opinion that it will in time completely supersede gas in the illumination of all external spaces and large internal areas. We shall not stay to combat any of the author's views, some of which are open to criticism, but we have no hesitation in expressing an opinion that this book, accepting the purposes for which it is written, is a very useful production. It gives a plain and correct account of all the systems of electric lighting, well illustrated by plates, which show the peculiarities of each invention, and any of our readers who wish for information on this subject cannot do better than go to Mr. Shoolbred's book. As regards the "Prospects of the Electric Light"—the chapter with which Mr. Shoolbred concludes his work—we shall say nothing. We wait for time to reveal what future applications of the light will be made. After all that has been said, we have not the smallest fear that electricity will be at all inimical to the interests of gas and those who supply it. There is, as we have said, a sufficient field for both. The author thinks that electricity may be applied, with excellent results, to iron-works, cotton mills, and railway stations, both goods and passenger. We have read somewhere, but cannot remember where, that the light may be usefully employed in agricultural operations. We have hitherto always been told to make hay while the sun shines; now we may be told to make hay while the electric light shines, always supposing that the dew would not rise. Hoeing turnips, too, could hardly be carried on under an electric light at a long distance off; but it is useless to dispute the merits of the light, which will have its special functions. It will never invade our houses, and is perfectly unadaptable where small amounts of illumination are required. These considerations, however, do not interfere with the value of Mr. Shoolbred's book, which may be consulted with advantage by all who wish to know the present condition of the electric light.

National Water Supply.—The Annual Conference at the Society of Arts, on National Water Supply, Sewage, and Health, was held last Thursday and Friday, when, owing to the absence, through ill health, of the Right Hon. Jas. Stansfeld, M.P., late President of the Local Government Board, the proceedings were opened by Lord Alfred Churchill, Chairman of the Council of the Society. We recently announced the offer by the Society of one gold and three silver medals for suggestions for dividing England and Wales into districts for the supply of pure water to the towns and villages in each district. The Committee appointed to inquire into the merits of the papers sent in, reported that they were of opinion that no one of the essays was worthy of a gold medal; but selected two, by Mr. F. Toplis and Mr. J. Lucas, for silver medals. Papers and discussions were then taken under the following heads:—1. Methods of securing a sufficient supply of pure water. 2. Evils of impurity, and consequent connection of the water supply and sewage. 3. Methods of sewage, &c. As opportunity offers, we may reproduce some of the papers in the Journal. At the close of the discussions on Friday, the following resolution was passed:—"That this Conference wishes to express its entire satisfaction at the action taken by His Royal Highness the Prince of Wales, President of the Society, in applying to the Government for the appointment of a Royal Commission to inquire into the water supply of the country, and earnestly hopes that the Government will takes steps without any delay to carry into effect the resolutions passed at the meeting held last year." This has reference to the letters published in our issue of April 15, p. 558. A further resolution—"That this Conference recommends the Council to arrange that a deputation shall wait upon the Government to urge the necessity of taking every legislative means to prevent the continuance of the pollution of the Thames by sewage," was carried with one dissentient. An Exhibition of Mechanical and Chemical Apparatus, relating to water supply, treatment of sewage, and health, was held at the Society's rooms during the Conference.

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* "Electric Lighting and its Practical Application, with Results from Existing Examples." By J. N. Shoolbred, B.A., M. Inst. C.E. London: Hardwicke and Bogue. 1879.

Water and Sanitary Notes.

THE Annual Conference at the Society of Arts, on National Water Supply, Sewage, and Health, was held on Thursday and Friday last. The first proceedings related to the mapping out of England and Wales into watersheds and drainage districts. The papers presented on these subjects were unfortunately of very little interest. The idea, we believe, was first started in these columns, and we stated that a few competent Engineers, with Ordnance maps in their hands, could easily, within a few weeks, divide England and Wales into districts which, for the purposes of water supply and drainage, should topographically fulfil all the conditions which are required. The conservancy of rivers would necessarily form a part of the functions of any body constituted to superintend the distribution of water. We have, after all, certainly in the South of England, to depend mainly on a river supply, and it is of the utmost importance that care should be taken to preserve these streams as free as possible from pollution. In the North, where great catchment systems exist, the question is not of so much moment. The thing to be settled in those cases is, that a district belonging naturally to one town shall not be encroached on by another. That would be one of the great difficulties which any body of Commissioners, or whatever they may be called, would have to settle. It must be admitted that at the present time several towns in the North of England have appropriated areas for catchment systems, which, if the principles of physical geography had been admitted, would have been allotted to other towns. However, it is too late now to make remarks upon these perversions. For the time, the system of the water supply of England is settled, and it will require an immense effort to change our common sources of supply. The wells in the new red sandstone and in the chalk southwards may be left out of the question. The supply from them must, of necessity, be local, and it requires no effort of legislation to make them available. Well water of an uncertain quality can be obtained almost everywhere, and from such sources a large portion of the community must necessarily depend for a supply. The "Abyssinian" tube wells, described by Mr. Sutcliff, furnish perhaps the readiest means of obtaining water. For the most part, it is surface water, the character of which may be doubtful. But it is water, and so is acceptable. For village supplies, these wells are extremely useful, and a more extensive employment of them is desirable. It matters little, to our mind, what the chemical quality of the water is, for, as our readers know, we have no confidence in the reports of analysts; at all events, so far as they pretend to assess the quality of the water in relation to health.

When so much stress is laid on the relation of water supply to health, especially in this Metropolis, it would be of the highest interest if we could obtain separate returns of the rates of mortality in the districts of the several Water Companies. It is, however, useless to ask for them; but, if they could be obtained, we believe they would be valuable in showing that there is no connection between death-rate and the quality of the water supply. We have little doubt that the Kent Company's district would show badly, while that of the Lambeth would exhibit more favourable results. But in neither case could any inference be drawn as to the influence of water supply on health. The fact is that density of population is the prime factor which governs death-rate; next comes the habits of the people; and then consideration must be given to the condition of the houses they dwell in. The foundations of these require earnest attention. Cholera and typhoid fever prevail where pervious foundations exist. The exhalations from a sewage-saturated soil do the mischief which is commonly ascribed to bad water. Nothing has done more to promote the health of our population than the good pavements, which, we are happy to say, are now almost universal; and if, in the future Metropolitan Building Act, it be enacted that the foundation of every house shall be concreted to a depth of six inches, and asphalted, a number of diseases will disappear. We still hope that, putting aside the prejudices which now reign, some really candid and independent investigations will be made into the conditions which do affect the health of a community. We notice nothing of the kind in the proceedings in the Adelphi. There it seems to be assumed that water which they call bad, and sewage which we all know is bad, produce all the evils of which complaints are made; other considerations are altogether excluded from view, which we regard as a huge mistake. Let us keep our water as pure as we can, and get rid of our sewage as fast as we are able.

The mortality of London returned last week to what we may call its normal rate, twenty-three per thousand—a figure which, on the average, has been maintained ever since returns were made under the Registration Act. Coincidently, Dr. Frankland reports an improvement in the quality of the Metropolitan Water supply. The supply from all the Thames Companies, with one exception, obtained his approbation. The Lambeth Company, whose supply is commonly objected to, is reported on as the best water supplied from the Thames, while the New River Company, whose water is ordinarily reported as excellently pure in quality for a river supply, is characterized as inferior to the waters taken direct from the Thames. Altogether this is highly satisfactory, and the Water Companies may take comfort, seeing that, under circumstances over which perhaps they have no control, the water they supply obtains the approval of their merciless critic. Considering all things, the health of the Metropolis may be said to be re-established, and if we can only get some genial spring weather, the death-rate will no doubt be further reduced.

The Auditor of the Metropolitan Board of Works has disallowed the expenses incurred in the promotion of the two Water Bills last session, amounting to sixteen thousand odd pounds. The papers report that the members of the Board are surcharged this sum; but this is not exactly true. The amount, as we have said, is "disallowed;" but the money must be forthcoming, and it will no doubt be provided for in the next Money Bill promoted by the Board. They may, however, take the lesson to heart, and learn that they have no power to spend money in harassing Water and Gas Companies. One very bold member of the Board, at the onset, warned the members that they had no power to expend the ratepayers money in the promotion of such Bills as those presented last year; but a reckless disdain of legal consequences led the Board to proceed with measures which utterly failed. No commiseration need be expressed—the members will not be mulcted of £400 each. Still, as we have said, a useful lesson has been taught them. Before the Board again launch out in extravagances of the kind, they will get good legal advice, and be careful not to run beyond the length of their tether.

Dr. Farr, F.R.S., and Mr. Edwin Chadwick, C.B., have expounded their views as to the economics of the Metropolitan Water Supply. They have no particular regard to the present generation of consumers, but they are extremely anxious that the undertakings shall be transferred to some authority which will distribute water more cheaply, if not of better quality. The price these gentlemen assess as the value of the undertakings, supposing them to pass into the hands of some public authority, is a perfectly absurd one. The undertakings might have been bought for something like £26,000,000 about ten years ago; to-day they could not be purchased for anything like that sum. But why should they be purchased at all? The bitter enemies of the Water Companies, whose names we have quoted above, admit that all that is required is unity of management, under which large savings would be effected, and great facilities provided for the supply of water. These advantages can be as well secured by arrangements made between the Companies themselves, as by any authority constituted by Act of Parliament or under the direction of the Privy Council. Let the Water Companies take this matter into serious consideration, and we are certain that if they will only combine their forces, complete satisfaction to ratepayers and consumers will result.

The Colchester Water-Works purchase is now an established fact. The Bill passed through Committee last week, and will not be further contested. The terms of purchase assented to were referred to some weeks ago, but we shall have to mention them again when everything is concluded. The terms, so far as we know, are very favourable to the proprietors of the works, who may well be contented with the sum which is to be paid to them.

WASTE OF WATER IN CARMARTHEN.—At the quarterly meeting of the Carmarthen Town Council last Wednesday, the Surveyor complained of the waste of water going on in the town. He said that allowing 100 gallons a day to each of the 1300 houses connected with the mains, only 130,000 gallons were accounted for, while the total supply was 190,000 gallons. He recommended the Council to order that every communication-pipe should have a high-pressure stop-tap under the pavement in front of the house, so that the pipes should be under the strict control of the waterman. A discussion on the proposal was commenced, and adjourned for a fortnight.

THE RECENT LOCAL GOVERNMENT INQUIRY AT MIDDLESBROUGH.—At the quarterly meeting of the Middlesbrough Town Council, held last Tuesday, it was reported that a Local Government Board Inspector held an inquiry on the 16th of April, and that the Local Government Board have since issued a Provisional Order under seal, granting the prayer of the Corporation's petition. It may be remembered that at the inquiry referred to, the Town Council applied for power to borrow the sum of £2696 9s. 9d., the expenses of obtaining the Middlesbrough Improvement Act of 1877, and to capitalize the same; to do likewise with the moiety of the cost (£28,652 12s. 5d.) of opposing the Bill of the Stockton and Middlesbrough Water Company, and subsequently obtaining an Act to purchase the works; and further to capitalize the sum of £10,482, the expenses incurred in obtaining £400,000, the amount of the precept served upon the Corporation on account of the purchase.

THE PORT SANITARY AUTHORITY AND THE THAMES.

A REPORT presented to the Court of Common Council, by the Port of London Sanitary Committee, on the 1st of the present month, contains certain statements which may naturally excite some feelings of surprise and annoyance in the public mind, especially when commented upon in the style adopted by the *Lancet*, in one of the leading articles of that journal a few days back. Our contemporary has ventured to state, in commenting on this report, that "not less than 411 sewers still "open into the Thames within the limits of the Metropolitan "Board of Works jurisdiction," and that out of this number as many as 176 "certainly contribute—some, it is to be pre-"sumed, largely—to the foulness of the river!" The assertion, it may be noticed, is somewhat guarded, though it seems alarming enough at first sight. But there is sufficient emphasis in that which follows, where we read:—"How the great "number of sewers still pouring their foul contents into the "Thames, within the Metropolitan area, come not to have "been intercepted in completing the great main drainage "scheme, it is for the Metropolitan Board of Works to explain." "The fact," we are told, "is unutterably scandalous, as touching "the fashion of the work of a great public body, and the Port "Sanitary Authority deserves the thanks of the Metropolis in "bringing it to light."

All that the Port Sanitary Authority says, or seems to say, or is said to say, will be implicitly believed by a large number of people. It will be complained that London has expended some five millions of money on an illusion, and that, despite the great intercepting sewers, the sewage is only partially intercepted. So far as concerns the article in the *Lancet*, the argument is based on the idea that throughout the whole Metropolitan area, nothing of a liquid nature, unless it be the water of an open and unpolluted stream, should enter the river except at the great sewage outfalls at Barking Creek and Crossness. Those who have a practical knowledge of the subject need not to be told that no possible expenditure of money would bring about such a result as this. We might as well talk about having a railway from London to York without a curve and without a gradient. Or, in other words, but with the same purport, it might as well be suggested that a boiler should be made sufficiently strong to be safe without a safety-valve. It is absolutely necessary, in respect to a large drainage area like that of London, that there should be storm outlets connected with the sewers. Some people may argue that a storm outlet is only a sewer with another name. There is, however, an essential difference between the two things. A sewer always contains more or less sewage, and is in full operation once, if not twice in the twenty-four hours; whereas a storm outlet remains dry and inoperative except on the occasion of a heavy rainfall. No such distinction is made by the *Lancet*, everything being treated as a "sewer" that opens its mouth on the foreshore. It is true that some kind of distinction is implied, though we are not told what it is. After the declaration that more than four hundred "sewers" still open into the Thames within the jurisdiction of the Metropolitan Board, it is asserted that among these there are one hundred and seventy-six which "certainly contribute" to the foulness of the river. There are said to be more than a hundred of these unequivocal "sewers" on the south side, thus leaving only seventy on the north side—a statement which affords some indication of the real fact. It may seem odd almost to absurdity, but it is nevertheless true, that some of the so-called "sewers" on the south side act more frequently as inlets than outlets. The sewerage of the south side lies low, and at certain periods of the tide it is the practice to let Thames water into the sewers on the south side, for the purpose of flushing them.

Taking the whole range of the south shore within the area of the Metropolitan Board, from Putney to Crossness, we cannot learn that there are more than a dozen storm outlets. What, then, are the ninety others? Some, we believe, are old disused sewers—mere relics of the past, which nobody has cared to remove. Others are probably drains from houses and yards. The latter ought, of course, to be abolished, by having proper connections established with the district sewers. This is a duty which, we believe, devolves on the Metropolitan Board, and if there has been any remissness at all, it is in this particular, though there are tokens that the work is not altogether neglected. Passing over to the north side, it may happen that there are no flushing inlets; but that there are any "sewers," properly so-called, discharging into the Thames, we greatly doubt, excepting in the case of North Woolwich. There is something anomalous in the state of things east of the River Lea, and it would seem as if some provision ought to be made for draining that populous district into a sewer discharging itself by the side of the present Metropolitan outfalls. At all events, some further drainage facilities are wanted in that quarter.

The statements in the *Lancet* are in reality based on a "Special "Report" by the Medical Officer of Health for the Port of London, Mr. Harry Leach. On looking into this document, we find that the *Lancet* has gone a little astray. There are alleged to be altogether 176 "foul" outfalls in the jurisdiction of the Metropolitan Board. The number—411—given by our contemporary refers to "other" outfalls, which obviously are not "foul," although declared by the *Lancet* to be sewers which still open into the Thames within the limits of the Metropolis. It would be bad enough if there were really 176; but, at all events, we may be thankful for a discount of sixty per cent. The number, however, ought to be still further reduced, the Metropolitan Board being made accountable for twenty-nine "foul" outfalls at Barnes, which are not in their jurisdiction. This would reduce the total to 147. Of all this number, we question whether there is one that ought to be called a sewer. The storm outlets are not likely to act, on the average, more than about once a month, and, putting the whole together, the pollution of the Thames from this source must be extremely small. That it would be better to get rid of everything except the storm outlets and the flushing inlets there can be no doubt, and this process appears to be going on, as we have already intimated, judging by statements which occur in the report of Mr. Leach.

We have heard it said lately, and possibly there is some truth in it, that whereas in a former age people were priest-ridden, now they are press-ridden. The notion is not likely to be popular, but it just simply points to a possible abuse of the power of the press—a power which, on the whole, is so beneficent that it seems ungrateful to complain of it. But we see in the present instance how easy it is to raise dissatisfaction concerning a great public work which has been admirably carried out, and which only needs the slightest possible touch here and there in order to defy criticism. If the main drainage system of the Metropolis is defective, it is not with regard to these "sewers," which are said to be still discharging into the Thames, but with reference to something having a much wider scope and bearing, and for which the Metropolitan Board are not responsible. In addition, it may be contended that the great outfalls at Barking and Crossness ought to be carried farther seaward. But the question is one of expense, and we doubt whether the gain would be considered commensurate with the cost. At all events, the system, as originally devised and approved, has been well carried out; and whatever faults appertain to the Metropolitan Board—we certainly can specify some—it is going much too far to say, as we read in the *Lancet*, that the Board have conducted the great main drainage scheme to an issue which is "unutterably "scandalous." Mr. Leslie, who generally puts himself in the wrong when he might otherwise be occasionally right, could scarcely make a greater error than in speaking thus of what the Metropolitan Board have done for the Thames.

There are some analyses attached to Mr. Harry Leach's report which seem a little out of place. We allude to two sets of three each, having reference to water taken from the Thames in the month of December last. In the first instance, the analyses are by Dr. Paul, who writes a note to Mr. Harry Leach, saying: "The results of the analysis of the three samples of "water show that they all are of very bad quality, and, in my "opinion, unfit for drinking." But where does the reader think the samples came from? Were they drawn from the Thames at Sunbury, at Hampton, or Thames Ditton? By no means. One was taken "below Putney Bridge," another from "below West-"minster Bridge," and the remaining one from "below London "Bridge!" We should like to know who drinks, or thinks of drinking water taken from such sources? What possible connection is there between these analyses and the water supply of the Metropolis? The other set of experiments is by Dr. C. Meymott Tidy, who deals with samples derived from the same sources, but taken a few days later. Dr. Tidy says nothing about drinking such water, but he shows its quality, and states that the water collected below Putney Bridge is "the purest," while that from below London Bridge is the "least pure." This comparative result might be expected, only we find Dr. Paul reporting: "The sample marked C is decidedly the worst "of the three as regards impurity," and this particular sample is the one which in Dr. Paul's analyses was "taken below Putney "Bridge." Therefore, the state of things at Putney is not quite so clear as might have been supposed, one doctor finding the water there greatly better than at London Bridge, and the other finding it greatly worse. We confess if we had to undergo the "ordeal by tumbler," we should rather go to Putney.

We must now go a step further. Mr. Harry Leach says, "No report on the subject would be complete that does not "include all sources of pollution, not only from Teddington

"Lock (where your jurisdiction commences) downwards, but "from above also, as far, at all events, as Oxford or Abingdon." Commencing at the former city, we are told "there are, or were "until very recently, pollutions of the river in the shape of out- "falls at Oxford, Abingdon, Wallingford, Streatley, Pangbourne, "Caversham, Henley, Maidenhead, Windsor and Eton, and so "on to Hampton Wick and Kingston, to Teddington." We have quoted the list, but we fear it conveys scanty information to the reader, who, like ourselves, has his choice between the "are" and the "were." The report then proceeds to state that below Teddington Lock "there are some eight other "places to Chiswick, all of which still drain into the river." But it is added that, "with some two or three exceptions, these "towns have recently united for drainage purposes, and, within "the next two years, it is anticipated, will have diverted all "their sewage from the stream." From Teddington to Chiswick there are stated to be seventy-five "foul" outfalls on the north side, and forty-two on the south side, provided we include Barnes, which is debited with twenty-nine. Kingston and Petersham have none.

Having reached the upper boundary of the Metropolitan area, we now pass over the intervening space and start afresh at the lower boundary. Here we find the two great Metropolitan outfalls, whose existence, of course, is undeniable. The sewage of Barking is said to be "still discharged into the Creek." The Barking people once complained, in a memorial to the Home Secretary, that the Creek was polluted by the discharge from the northern outfall. The tables are now turned, and Barking is specified as adding by its own sewage to the pollution of the Thames. Proceeding down the river, our attention is drawn to outfalls which are mentioned as existing at Erith, Purfleet, Dartford and Dartford Creek, Greenhithe, Grays, Northfleet, and Gravesend. The speedy completion of the West Kent drainage system is adverted to, one of the results of which will be the discharge of a "so-called effluent" into the Thames, nearly opposite the village of Purfleet, off which is moored the *Cornwall* schoolship. Sewage is evidently a great offence to the Port Sanitary Authority. Not even an "effluent" can be patiently endured, although associated with a drainage system intended to keep the watercourses pure.

It is proper to observe that, in the course of his report, Mr. Harry Leach carefully avoids some of the extreme notions which are only too prevalent. While complaining of the pollution caused by the great Metropolitan outfalls, he considers it would be "highly sensational and improper" to allege that the foul state of the water hastened the death of the persons drowned in the *Princess Alice* collision. His reference to the various sewer outfalls below the Metropolitan boundary is also intended, in conjunction with other matters, to show that "the main drainage "outfalls must not, in a sweeping way, be made entirely respon- "sible for the present foul state of the river between London and "Gravesend." It is admitted that the great floating population on board the ships in the Thames occasion a large amount of pollution, for which it seems impossible to provide a remedy. Respecting the great outfalls, there is in this report a moderation of tone which has not characterized all we have heard on the subject. The outflow of sewage, it is stated, can be traced in the current of the river at half ebb for about a mile in the case of the northern, and about three-quarters of a mile in the case of the southern outfall, "after which each and both become "mixed with, and lost in the water of the river." There is one statement made in the report which seems to call for the special attention of the Metropolitan Board. Thus Mr. Harry Leach writes: "I am informed that the storm outlets of the "main drainage system receive, surreptitiously, the drainage "from many houses near the river, and this statement might, of "course, be substantiated if these outlets were watched con- "tinuously at low water for, say, a week; but at present I have "no proof as to the correctness of these reports." We are inclined to think there are practical difficulties which render it extremely unlikely for storm outlets to be abused in this way.

We may expect that, in course of time, there will be a rejoinder from the Metropolitan Board in reference to the alleged defects of their main drainage system. Concerning the Barking and Crossness outfalls, there is a passage in the ordinary half-yearly report of Mr. Harry Leach, which suggests the possibility of "legislative action" "on the part of the Cor- "poration, either independently, or in conjunction with the "Thames Conservators, with a view to prevent the very great "amount of pollution of the River Thames that is persistently "going on" within the jurisdiction of the Port Sanitary Authority. This pollution, it is observed, is caused "chiefly by "the main drainage outfalls, which outfalls are constructed and "maintained by the Metropolitan Board of Works." Thus the absence of unity in the government of London has the advantage of setting one Authority to watch another. In like manner, some people think it is better to let the Gas and Water Companies remain alive, so that they may be badgered and worried by the powers that be, seeing that if the Municipal Authority were to supersede the Companies, there would be great difficulty in maintaining the badgering and worrying process in its full integrity. On the same principle, the Corporation and the Metropolitan Board are expected to hold each other in check, except when they unite against the Companies. Such are some of the perturbations which affect the complicated system—"cycle "on epicycle, orb on orb"—of the great Metropolis. If the Gas and Water Companies sometimes receive a rude shaking, the Local Authorities occasionally share the same fate, even at the hands of one another.

A TREATISE ON THE SCIENCE AND PRACTICE OF THE MANUFACTURE AND DISTRIBUTION OF COAL GAS.

CLXXX.

THE TREATMENT OF RESIDUAL PRODUCTS.

Carbolic Acid, or Phenol ($C_6 H_6 O = C_6 H_5 OH$).

This substance, which is now of great commercial importance, was discovered in 1834 by Runge, in the course of his memorable researches upon coal tar. Reichenbach in 1832 had isolated from the tar of beech-wood a substance to which he gave the name of creosote, and as for a long time the two products were considered to be identical, Runge's carbolic acid acquired the name of coal-tar creosote, a name by which it is sometimes called now, but which is more frequently applied to the heavy oils of coal tar. (See this volume of the Journal, p. 309.)

Carbolic acid is also known by the names of phenol, hydrate of phenyl, phenylic alcohol, phenic acid, phenous acid, hydrated oxide of phenyl, spirol and salicon. In scientific works it is almost invariably known as phenol. Phenol, in addition to being found in coal tar, is produced in a considerable number of reactions. It is formed during the dry distillation of salicylic acid, and, as we shall see presently, the latter acid in its turn can be produced from phenol. It is also found among the products of the destructive distillation of the resin of *Xanthorrhœa hastilis*. The latter substance yields trinitro phenol, or picric acid, when treated with nitric acid, a reaction which is also undergone by phenol itself under the same circumstances. Phenol is also formed during the dry distillation of gum-benzoin, quinic acid, chromate of pelosine, and when oxybenzoic acid is distilled with lime. It is also produced, according to Berthelot, when alcohol or acetic acid is passed through a red-hot tube, and by heating acetylene with fuming sulphuric acid, by which it is converted into the acid $C_2 H_2 SO_3$. This acid is then converted into a potassium salt and fused with caustic potash. The acetylene is then separated and polymerized, and the polymeric compound takes up oxygen, and is converted into phenol. It is also produced by distilling glycerine with chloride of calcium, and by fusing phenylsulphite of potassium with excess of caustic potash. Monochlorobenzene heated to 300° C = 572° Fahr. with caustic soda yields phenol. It is also found in the urine of the horse and the cow, and is produced in a considerable number of reactions besides those enumerated, but for further details the reader is referred to works on organic chemistry.

Phenol is prepared from the oil of coal tar which distils between 150° and 200° C. = 302° to 392° Fahr. This constitutes the crude medium oil in the classification of MM. Girard and De Laire. To prepare phenol from this portion of the distillate from coal tar, the latter may be treated with a saturated solution of caustic potash mixed with caustic potash in powder. A white crystalline magma is thus obtained, which is to be dissolved in hot water, and allowed to stand until all the oils insoluble in the alkaline solution separate and rise to the surface. The insoluble portion consists of a mixture of hydrocarbons and volatile bases, holding naphthalene in solution. The oily upper layer is to be separated from the alkaline solution by a tap funnel on the small scale, or by an apparatus of a similar kind made of iron or stoneware if large quantities of solution are to be operated upon. On neutralizing the alkaline solution with hydrochloric acid, phenol, containing its next homologue cresol, or hydrate of cresyl, $C_7 H_8 O$, rises to the surface. The mixture is to be washed with a little water, and dried by means of chloride of calcium. The product so obtained is to be rectified several times, remembering that carbolic acid boils at 184° C. = 363·2° Fahr., according to Williamson and Scrugham, and cresol, or rather the cresols, at higher temperatures. It must be remembered that as there are three toluidines (see this volume of the Journal, p. 591) so there are three cresols—namely, para, meta, and orthocresol. Paracresol is said to boil at 198° to 200° C. = 388·4° to 392° Fahr.; metacresol, at 195° to 200° C. = 383° to 392° Fahr.; and orthocresol at 189° C. = 372° Fahr. Ortho and metacresols do not solidify in a freezing mixture; but paracresol at that temperature solidifies to a crystalline mass, which does not fuse again at ordinary atmospheric temperatures.

To return to our process, the impure phenol, prepared as before described, is to be cooled to − 10° C. = + 14° Fahr., and, a few crystals of pure phenol having been introduced, a large portion of the liquid will, on repose, solidify; the solid part is then to be drained from the fluid, and rectified at 184° C. = 363·2° Fahr.

From what has been said it will be seen that phenol may be freed from meta and orthocresols by freezing, and from paracresol by rectification.

It must be mentioned that the boiling points of the cresols are not definitely settled, and that the above numbers can at best only be considered as near approximations. The above process for the preparation of pure carbolic acid is founded upon that of Laurent, but modified in accordance with the results obtained by Williamson and Scrugham, and the researches of Engelhardt and Latschinoff.

Hugo Müller has devised a process which is intended to eliminate from the resulting phenol those substances which tend to turn it brown on keeping. The coal oil of the same character as that described in the previous process is to be treated with caustic soda or milk of lime, or a mixture of the two. The alkaline solution having been separated from the insoluble oil, is to be diluted with water until no more naphthalene separates out. The liquid, in addition to phenol and the cresols, contains a substance which readily oxidizes when its alkaline solution is exposed to the air; the oxidation is accompanied by the formation of a dark brown substance. The operation is performed in shallow earthenware pans, so as to expose as much surface as possible to the atmosphere, and the liquid should be frequently stirred. After a few days, the solution is to be filtered, and the number of gallons ascertained. A measured portion is then taken and acidified with hydrochloric acid, the quantity required for the purpose being carefully noted. The acidified liquid being then introduced into a graduated glass tube, the amount of impure phenol present in the quantity of alkaline solution originally taken may be read off. The quantity of hydrochloric acid required to precipitate all the phenol present is then to be calculated from the result obtained on the small scale, and a sixth part of that quantity added to the whole of the alkaline liquid contained in a suitable vessel. During the addition of the acid the liquid is to be vigorously stirred; by this means a precipitate will be obtained. It consists partly of a resinous substance produced by the oxidizing action of the air on the impurities previously alluded to, and partly of the higher homologues of phenol. By careful fractional precipitation, the latter may be so far removed that at last comparatively pure phenol is obtained. The first and impure precipitates having been separated, the latter ones may be tested by heating to nearly their boiling points in a current of dry air to remove the moisture. When quite dry, the product should crystallize quite readily after distillation and proper cooling. The crystallization may be assisted, as was mentioned in describing the first process, by the introduction of a small quantity of crystallized phenol.

The smell of the product obtained according to the foregoing directions, may be greatly improved by a rectification over litharge, which will remove the sulphide of phenyl generally present.

Phenol crystallizes in needles which are colourless when pure. Its specific gravity, according to Laurent, is 1·065 at 18° C. = 64·4° Fahr., which nearly agrees with the determination of Scrugham, which gave 1·0627. Its melting point, according to Laurent, is between 34° and 35° C. = 93·2° to 95° Fahr., and this number has been adopted in most works on organic chemistry; but Mr. Lowe gives 42·2° C. = 108° Fahr. as the melting point of his pure phenol, which is now an ordinary article of commerce. It is evident that as the writers on phenol were, until lately, unacquainted with the properties of the three cresols, and especially with the fact that paracresol crystallizes and retains the crystalline condition at ordinary atmospheric temperatures; the specific gravities, melting and boiling points of all these substances, will require careful revision.

Phenol is largely used as an antiseptic. The great success which has attended its use in surgery, in the hands of Professor Lister, is too well known to require comment. Inhaled with the vapour of water, it is invaluable in certain inflammatory conditions of the mucous membrane. The writer has seen a case of an ulcerous sore on the head, which had commenced to attack the bone, at once arrested, and rapidly cured, by lint dressings steeped in a very dilute solution of phenol in water.

Phenol may be distinguished from wood-tar creosote by its behaviour with an alcoholic solution of ferric chloride; the former (in alcoholic solution) is turned brown, while the latter, under the same conditions, yields a brilliant green colouration.

Salicylic Acid ($C_7 H_6 O_3$).

This substance, like phenol, has become of great importance as an antiseptic, and also in consequence of its physiological action. It was formerly obtained from the flowers of the *Spiræa Ulmaria*, from salicin, or from the oil of wintergreen (*Gaultheria procumbens*). When required very pure for pharmaceutical purposes, it is frequently prepared from the latter now, although the process is a somewhat costly one.

It has long been known that salicylic acid, when rapidly heated with sand, pounded glass, or quicklime, was decomposed into phenol and carbonic anhydride; and it was also found by Kolbe and Lautemann eighteen or nineteen years ago, that sodium phenol might be converted into salicylic acid in presence of carbonic anhydride. For this purpose, fragments of sodium were added to warm phenol, while a current of dry carbonic acid was passed in. The reaction between carbonic anhydride and sodium phenol commences at temperatures below 100° C. = 212° Fahr., but is most energetic between 170° and 180° C. = 338° to 356° Fahr. The temperature is to be raised gradually to 250° C. = 482° Fahr., and as much phenol distils over as is equivalent to about one-half of the sodium phenol present. When no more phenol distils over, the operation is finished. The residue is to be treated with hydrochloric acid, and the salicylic acid which is liberated is to be purified by dissolving in a solution of carbonate of ammonium. The filtered liquid is to be evaporated until it acquires an acid reaction, filtered from a resinous impurity, and treated with hydrochloric acid to again separate the salicylic acid. The latter is then to be dissolved in hot water, boiled with pure animal charcoal, filtered, and put aside to crystallize.

In February, 1874, Mr. Johnson, the Patent Agent, took out a patent for "Improvements in the Production of Salicylic Acid, and of the Isomeric and Homologous Acids," being a communication from Professor Kolbe. The complete specification, which was filed at once, states that the process for producing salicylic acid by passing carbonic anhydride into boiling phenol while sodium was being dissolved in it, had certain disadvantages; which is, in fact, obvious, having regard to the production of a commercial article at a reasonable price. It then proceeds to state that salicylic and other acids of the aromatic series can be produced by the action of carbonic anhydride upon phenol in the presence of alkalies or alkaline salts, in large quantities, and at less cost than with the other methods in general use.

In 1877 a patent was granted to Max Neustadt for "Improvements in the Manufacture and Production of Salicylic Acid, and in Apparatus employed therein," being a communication from Emanuel Merck, of Darmstadt. This patent claims the production of basic sodium salicylate, by acting with carbonic anhydride upon dry sodium phenol at certain temperatures, and with the use of special apparatus.

The manufacture of salicylic acid by Messrs. Merck under their patent was opposed by Dr. Van Heyden, of Dresden, as assignee of the patent granted to Johnson, and led to a nine-days trial before Vice-Chancellor Bacon. The decision of the Court was in favour of Johnson's patent, but we understand that there will be an appeal.

The salicylic acid of commerce, as made by acting with carbonic anhydride upon sodium phenol, appears, from the results obtained by Mr. John Williams, to be a mixture (*Pharmaceutical Journal*, April 6, 1877). According to that chemist, the pure natural acid—by which term he designates that obtained from oil of wintergreen—differs greatly in solubility from the commercial acid obtained from phenol. A drachm of the former requires about 3 ounces of boiling water to dissolve it; whereas the same quantity of the best commercial acid from phenol will dissolve in 2 ounces, and a low quality in 1½ ounces. This simple method of discriminating between a pure and an impure acid is of great value, inasmuch as it is stated by Mr. John Williams that the administration of an impure acid internally is frequently followed by great pain and irritation of the stomach.

For an account of the discussion between Meyer, Kolbe, Hempel, and others on the antiseptic properties of salicylic acid on beerworts, &c., the reader is referred to the *Journal of the Chemical Society*, January, 1876, p. 101, and to the numbers for May and June of the same year.

It is a remarkable circumstance that if hydrate of potassium be employed, and the operation be conducted as before described for the manufacture of salicylic acid, the result will be principally para-oxybenzoic acid or one of the homologous acids; on the other hand, if the hydrates of sodium, calcium, barium, or strontium be used, salicylic acid or one of its homologues will be produced. It is proper to mention in connection with para-oxybenzoic acid, that Kupferberg has made the curious and important observation that it can be converted into salicylic acid by a process which has much affinity to the reaction by which the latter acid is produced from phenol. When neutral para-oxybenzoate of sodium is heated to 220° to 260° C. = 428° to 500° Fahr., in a current of carbonic anhydride, it is converted into basic salt, phenol, and carbonic anhydride. At 280° to 295° C. = 536° to 563° Fahr., the product consists largely of salicylic acid. At still higher temperatures the amount of salicylic acid produced is much less. (*Journal of the Chemical Society*, June, 1876.)

Communicated Article.

RETORT FURNACES IN GENERAL.

By "Isca."

When reflecting on the experiments which have been made, reports written, and remarks and opinions expressed on the subject of the distillation of gas from coal, and the appliances for that operation, or connected therewith, merely as far as the retorts and furnaces are concerned, from the earliest days of the practical introduction of gas lighting to the elaborate investigation into the working of gas generator furnaces at Leipzic during the past year, one must naturally be struck with the amount of consideration which this single division of the process of manufacture has from time to time received. This is not surprising when we remember that the department of carbonization is the *primum mobile* of the whole thing; for, as it is broadly put, money is made in the retort, elsewhere it is only saved. It is this fact also which always invests any experiments or observations on the subject with a certain amount of interest, and it is the general feeling that, the voluminous records of past inquiries notwithstanding, very much yet remains to be known respecting the evolution of gas from its coaly prison, which induces those who have the opportunity and desire to learn, to try systems of retort-setting, firing, and working in endless variety, and with differing meed of success.

In a measure, the multitude of devices for doing the same thing which we may observe in the case of coal gas distillation is analogous to the diversity of construction that is to be met with in steam-boilers. In both cases the widest stretches of fancy appear to have been realized in the shape and dimensions of the receptacles, be they known as boilers or retorts, and no less in the arrangements and methods by which heat is applied. But there is one great distinction between the processes of evaporating water and distilling gas, which is, that in the former the conditions necessary to be observed are known with true scientific exactitude, and in the latter they are

not. In one case, the amount of energy or power absolutely required to evaporate a unit of water is known, and consequently a reliable standard is available for measuring the efficiency of any boiler, as against any other boiler, or as regards its approach to theoretic perfection. And, therefore, when a given amount of work is demanded in any one instance, we know positively the very lowest cost in power at which that work can be performed; and, knowing this, we can strive our utmost to reduce the waste and extra cost, arising from inevitable imperfections of apparatus, to the least possible sum.

This may be illustrated in very few words. Supposing it is required to construct a boiler which shall evaporate, say, 5 cubic feet of water per hour at atmospheric pressure, taking the temperature of the feed water at 60° Fahr. Here we shall have to raise $62{\cdot}5 \times 5 = 312{\cdot}5$ lbs. of water $212° - 60° = 152°$ up to the boiling point, and to allow for the proportion which then becomes latent, we must add 966°; therefore, $152 + 966 = 1118°$, and $1118 \times 312{\cdot}5 = 349{,}375$ units of heat to be supplied for this purpose by the fuel burnt in the furnace. Knowing, then, the power of the fuel to be employed, we can design the whole apparatus in order to get as near the above expressed value as possible; because we know that every pound of fuel we consume beyond that necessary to yield the required energy is entirely wasted.

Nothing has tended so much towards real improvement and substantial economy in the construction and working of steam generators of all kinds as this rigid law, which is based on ultimate theoretic perfection, taken as the standard of every-day practice—a something so unattainable as to ensure a striking deficiency in the best models, and so arouse the ardour of competing designers, and yet quite commensurate with the poorest and most faulty appliances.

It is just this universally applicable and intelligible standard which is lacking in the case of the distillation of gas, and the consequence is that the only comparison of apparatus possible is that of one imperfect example with another, or with the average of similar arrangements, without reference to any reliable rule by which the absolute defect of all may be gauged. We may say with truth that a furnace which does as much work as another, with less expenditure of fuel, is the better of the two, other things being equal; but that does not preclude the possibility of both being bad, and it is therefore eminently desirable to have in this case also, if possible, a superior test, by which their actual waste may be as accurately determined as in the cited instance of a steam-boiler. Large sums of money, and infinite trouble, are continually expended in attempts to improve the arrangements for the carbonization of coal, and especially for the saving of fuel, and doubtless considerable gain would result, even to experimenters, if their course in this particular were more clearly marked out, and the limits within which their actions might prove hopeful sharply defined. For example, if one man succeeds in producing a steam-boiler which requires but an inappreciable surplus of fuel over the theoretic quantity, no one else will expend time, trouble, or money in endeavouring to surpass him; but if A. designs a retort-setting warranted to consume as fuel only 15 per cent. of the coke it can produce, B. must either be satisfied that further effort is hopeless, or he will probably try to do still better, because he cannot tell how near A. is to perfection.

Whether the determination of the energy required to raise, say, a pound of coal to the point at which all its gaseous constituents shall be driven off, will ever be completed with sufficient truth to be generally accepted as a datum for calculation in a practical way, is difficult to assert or deny. Something of the kind has, perhaps, been contemplated by investigators into the subject of the specific heat of coal and coke, which are evidently important factors in the problem; but the actual research into the matter would be attended with great labour, from the complexity of the collateral issues involved. Yet without at least an approximation to this value, it is impossible to say how much of the fuel, whether solid, liquid, or gaseous, by the aid of which distillation is performed, is truly necessary for that purpose, and how much is probably wasted up the chimney or dissipated in the retort-house.

We should probably be startled did we know, with any approach to the truth, the quantity of fuel consumed in what are considered good settings of retorts, in excess of what is really necessary for the production of gas. There are so many cooling influences to which a retort-stack is subject, aggravated as each source of loss is by the intense heat which must be kept up within, that, compared with these, the actual work to be done is scarcely more than an incidental drain on the power of the furnace. To begin with, the quantity of air admitted into the fire is generally vastly in excess of what is essential, and, of course, causes a fiercer combustion than is required; the conduction of heat through the furnace-casing is very great, and the products of combustion necessarily leave the setting at an exceedingly high temperature, taking away to the chimney as much unused energy as they have expended in the proper place. There probably is not a great amount of heat really absorbed in the evolution of gas from coal.

Take for example a setting of retorts carbonizing four tons of coal, and making 40,000 cubic feet of gas per diem. If the specific heat of the coal be about 0·25, that of water being unity, and that of the gas in volume 0·30, and if the coal be raised from a temperature of 60° to, say, 2000° Fahr. in the retort, and the gas to, say, 180° Fahr., the work done may be expressed as

$$(8960 \times (2000° - 60°) \times 0{\cdot}25) + (40{,}000 \times (150° - 60°) \times 0{\cdot}30) = 5{,}425{,}600 \text{ units of heat.}$$

If we further assume that such a setting will consume as fuel 25 per cent. of the coke it produces, this means, say, 1450 lbs. of coke, and, as stated by the writer in a former article, coke is capable of developing a power of 13,340 units per pound; therefore $1450 \times 13{,}340 = 19{,}345{,}000$ units of heat employed, where only 5,425,600 are required, which means a waste of 13,919,400, or about 72 per cent. of the consumption.

It must be understood that, in thus stating the case, the writer has not lost sight of the fact that the figures are liable to modification, should it be proved that the expansion of the gas, from the bulk of the coal to the volume it finally assumes, exerts a cooling influence on the mass contained in the retort, in which case that influence would have to be taken into account, as an addition to the sensible temperature of the gas. Whether it does, or does not, is at present matter for conjecture, and is just the point which requires to be settled in the course of the final solution of the whole problem. It may be suggested that although gas may come over with a temperature of 150° Fahr. only, yet coal exposed to that heat will give up no gas, and that, therefore, as a much higher applied temperature is necessary, the difference must be in the gas, although insensible, or, in other words, latent; and consequently the gas must take that amount of heat away from the retort. On the other hand, we have no evidence whatever that there is any heat latent in the gas, but that some may probably, and, indeed, must be expended in producing the molecular change, of which its separate existence is the result, but to what extent this expenditure takes place we are as yet in ignorance.

On the whole subject, in fact, more light would be beneficial. The amount of our waste would certainly be more keenly appreciated, and a fresh departure would probably be taken with a view to check the great loss which must be due to preventible causes. Some waste, of course, must always exist; but it would at least be some consolation if we could know its amount, and to what extent it may be said to arise from causes clearly beyond our control.

Correspondence.

[*We do not hold ourselves responsible for the opinions expressed by Correspondents.*]

THE ADVISABILITY OF GRANTING ELECTRIC LIGHTING POWERS TO GAS COMPANIES.

Sir,—As I find it impossible to reply to every inquiry made of me respecting this matter, I shall feel obliged if you will permit me to say a word or two upon the subject generally, which will probably answer the same purpose.

Some companies, I am sorry to find, think that gas companies ought to be allowed to supply the electric light; but I feel sure that this arises from not fully understanding what such a proposal amounts to.

Gas-making and supplying are now comparatively very simple matters to what they were; every item of cost can be calculated to a nicety, and with ordinary care maximum dividends are a certainty.

Electric lighting is, on the contrary, entirely new. There is no settled idea as to what is the best mode of applying it, no real knowledge of the cost, and not the smallest notion in the mind of any one as to how, in a general way, it should be worked. It would require a different plant, an entirely new and different class of workpeople, and different arrangements at every stage of proceeding. No general arrangements would suffice; every case in which it was applied would require special treatment, and it would need very serious consideration (if it is not high treason to say so) whether the manager of a gas-works was the fittest person to undertake it.

Gas is being made every hour in the day, and for three parts of the day (I give these proportions merely as an illustration) about one-fourth part of the quantity made is consumed, and the other three-fourths stored until required for use. In the other fourth part, all the quantity made is consumed, together with a considerable portion of the quantity previously stored. By these means—that is, making at one time and consuming at another—the large quantities of gas that are required at particular times can be made with a comparatively moderate expenditure of capital to what it would be if it had to be made as and when required. Gas, when made and put into the holders, is detached from the manufacturing process, so that the supply, whatever the quantity may be, is always free from the many casualties unavoidably attendant upon the manufacturing operations. The Companies are thus enabled to ensure at all times a constant and abundant supply.

Electricity, on the contrary, cannot be stored. Whatever quantity is required to meet a fog, or anything else, must be generated as and when it is required. The plant will, therefore, have to be arranged to meet this, and the cost on this account alone will always be enormously out of proportion to that for gas. The supply will always be dependent upon the manner in which the manufacturing operations are carried on, and any stoppage or irregularity in them will of necessity stop the supply. To provide a constant and abundant supply, as in the case of gas, is, under such circumstances, absolutely impossible.

Gas, when made and purified, is put into holders, for the use of the consumers, and then the manager's care with respect to that quantity is at end. From these stores the consumers, with their families and servants, *help themselves*—take any quantity they like, large or small, whether to fill a balloon or light a pipe, as and when they want it, day or night, without consulting or being interfered with by the gas company or any one else.

If any one can invent a more convenient system than this, he will deserve the gratitude of all mankind, and a good substantial pension as well; but until that is done, the gas companies have nothing to fear from the electric or any other light. The (when fully considered) wonderful convenience of gas will carry the day against any and every competitor, if the companies will but be true to themselves, and not be experimenting with the electric light to try and make it a success.

The electric light, if it ever can be used at all for lighting and domestic purposes, will require an engine and a dynamo machine for every cluster of houses—say, ten or twelve—with a separate coil for each house, and lamps of a special construction, with carbons for every light in each house; while at every additional number of houses or

lights the engineer will have to reconsider all his arrangements and adapt them accordingly; in fact, his work will never be at an end. When the machinery and apparatus are at work, the engine must be kept moving at an uniform rate, or the lights become unsteady, and the carbons must be made of the same material and substance all through, or the lights will be liable to suddenly go out.

Public lamps—all lighted and turned out at the same time, and placed under the control of one person—can, no doubt, be lighted by these means; but a number of private houses, each having its own arrangements, turning on and off as found convenient, cannot be so supplied, and no one as yet has ever attempted to show that they can be.

Taking all these matters into consideration, is it not a fair question to ask, whether it would be just to the shareholders who have invested their property in gas undertakings, and paid high premiums for the substantial security they afford, to embark in an undertaking which is so entirely foreign to gas, and which, in any event, must for a very long time be hazardous in the extreme?

I much doubt whether any of the companies who applied for powers to supply the electric light at the commencement of the session, ever considered what it led to, or how they were to carry out such a power, if granted. The only explanation that I have ever been able to obtain has been this: "We are merely asking for powers to supply the electric light in the same way as we now supply gas!" The applications were, no doubt, in most instances, prompted by alarm at the numerous reports in the public papers of the successful application of the light, and a want of confidence, notwithstanding their great advantages, in the stability of their own undertakings.

About this time last year the public, amused with the numerous reports of what was being done in Paris, were all anxious to have the electric light, and give it a fair trial. They have now seen it tried in the most favourable positions, and under the most favourable circumstances in a large number of instances, and it is no exaggeration to say that in no single instance can it be said to have been a complete success, and it would require very considerable persuasion to induce any one now to adopt it, except as an advertisement.

If powers are to be given to gas companies to supply the electric light, similar powers must be given to local authorities supplying gas—they cannot be given to one and not to the other; and if such powers are given, gas companies will never see the end of it. As it is, however, the rage for the light is dying out, and, if left to its fate, it will by this time next year be heard no more of, except as to places in which it can undoubtedly be made useful.

There is no need for gas companies to oppose the electric light—it cannot do them any harm; but, at the same time, it is not necessary for gas companies and local authorities in different parts of the kingdom to spend their funds in order to make it a success, to the prejudice of their own and all similar undertakings.

The companies are not now opposing the electric light, but simply the granting of parliamentary powers, which they allege are not really necessary, and would only give the light a fictitious value, to which it is not entitled, and thus prejudice gas property.

W. LIVESEY.

Gas and Water Companies Association, 6, Victoria Street, Westminster Abbey, S.W., May 17, 1879.

GAS AS FUEL.

SIR,—The papers of your contributor "Isca" are generally so ably written, and so full of information which must be useful to your readers, that they leave little room for criticism; but the article on "Gas as Fuel," in the number for April 22 (which other engagements have prevented my reading so punctually as I generally do), does not strike me as being quite so clear as usual.

The distinction which "Isca" seeks to draw between a room heated by a common fire and one heated by "previously heated air," though tenable, as a matter of fact, is scarcely susceptible of being explained on the hypothesis which he suggests. Our sensations do undoubtedly convince us that rooms which are warmed by ordinary fires have a more agreeable atmosphere than those which are warmed by stoves, just as the brightness and exhilarating effect of a sunny day is, as he suggests, more agreeable than the languor and depression experienced in sultry weather; but the reason is not in either case because it is more agreeable to be warmed by radiant heat than by a pre-heated atmosphere. In the case of the room, there are several other factors which have to be taken into consideration. In the first place, there is the fact that an open fire provides for the ventilation of the room in a much more efficient way than most stoves do. Secondly, all arrangements for heating, in which the heat is radiated from heated surfaces, whether they be of stoves, air-pipes, water-pipes, or what not, are liable to the annoyance that arises from the deposits on them of dust, which always consists mainly of organic *débris*, and which, when heated, gives off the musty disagreeable odour that is the chief source of the "oppressiveness" which is so frequently complained of in rooms heated by stoves. Lastly, the fittings of stoves are frequently defective, and allow either unburned gas or the products of combustion to escape, which helps still more to contaminate the atmosphere. In the case of the contrast between the heat of the sun and the earth, to which "Isca" alludes, the difference is due not so much to any difference in the source of heat as to the facts that on sultry days the air is more or less nearly saturated with moisture, and the electrical condition of the earth and atmosphere in a state of tension.

Whilst it cannot, I think, be denied that a coal fire in an *open* stove grate, standing fairly in the room, and with a supply to some part of its heated surface of air from without the room, is the most effective and agreeable mode of heating, and that such a fire is at least not more expensive than any other mode of heating, it is also certain that gas has such advantages for some purposes as to offer a large field for its use in heating-stoves. The most effective way in which gas can be used for heating is, as "Isca" points out, when mixed with air, as in the Bunsen burner. And where people are satisfied to burn gas without a flue to carry off the results of combustion, they cannot have anything so effective or so cheap as such a burner, placed, for mere purposes of protection, in any simple cockle arrangement. In such a case the whole heat of combustion is undoubtedly distributed through the rooms, but, unfortunately, in combination with vapours of water, carbonic anhydride, and other products, which must, sooner or later, unless the ventilation of the room is exceptionally good, unfit it for prolonged occupation, especially by delicate persons. It is when we seek to avoid this result, by carrying off the products of combustion by a flue, that the employment of gas as a source of heat becomes, instead of one of the cheapest, one of the dearest forms of heating. For so large a percentage of heat is in most stoves carried off with the products of combustion, that but little is left for radiation into the room, either directly from the flame, or indirectly from the surface of the chamber in which it may happen to be enclosed. There is only one remedy for this, and that is to extend the surface through which the products of combustion have to pass as much as possible *within the room*, so that as they pass away they shall be robbed of their heat; and to so arrange this part of the apparatus that the heat so absorbed shall be given off as rapidly as possible, both by radiation and conduction into the room. Any one who attacks this problem in a practical way, will find that—though the conditions which have to be realized may seem at first sight very simple, and though they are really not difficult to satisfy when the outlet-flue can be carried in an elongated fashion through the space to be warmed, as can be done in conservatories and other places in which appearance is not a matter of importance, when the absorbing surface has to be made a part of the stove itself, the accomplishment of the object involves all sorts of practical difficulties.

I believe that I have succeeded in overcoming all these difficulties, so far as it is practicable to do so, in my Euthermic stove, which is the result of a large number of experiments made in order to determine not only the form of apparatus best adapted to accomplish the object in view, but also the materials best suited for the purpose in regard especially to radiating and conducting power. The best proof that can be offered that this stove achieves all that it is practicable to do in this way is that the temperature of the products of combustion as they escape from the stove can be reduced to the lowest point which is consistent with maintaining a draught through the stove, and this is obviously the limit beyond which economy of heat cannot be carried.

I enclose with this a description of the stove for your information, and shall be happy to give details of its construction to any of your readers who may be interested in the subject.

Gloucester, May 10, 1879. FRANCIS T. BOND, M.D.

A QUERY.

SIR,—Will you allow me to ask my brother Managers, through your JOURNAL, if any of them can tell me about what quantity of gas per hour could be delivered through a 2-inch main 1½ miles long, pressure at works 16-10ths, under these circumstances? A gentleman has a 2-inch water-main laid, but the water smells, and also is not good to drink, on account of its stopping in the pipes so many hours before it reaches the house. He therefore wishes it converted into a gas-main. The house is about 50 feet higher than the gas-works, but there is a valley half way on the road, which drops, say, 30 feet. The valley, I should think, is 20 feet above the gas-works, but the drawback is that the 2-inch main will have to be supplied from a 3-inch main, which already has more consumers on it than it can well supply.

If some of your readers can give me practical information, I shall feel obliged.

May 16, 1879. B. A. T.

Parliamentary Intelligence.

HOUSE OF LORDS.

MONDAY, MAY 12.

The Pemberton Local Board Bill was reported, without amendment.

The Glossop Gas Bill was reported, with amendments.

The Houghton-le-Spring District Gas Bill was brought from the Commons, read the first time, and referred to the Examiners.

TUESDAY, MAY 13.

The Sleaford Water Bill was reported, without amendment.

Portsmouth Water Bill, Tipton Local Board Bill, Manchester Corporation Water Bill,—read the third time, and passed.

STANDING ORDERS.

Lord WAVENEY gave notice that on Friday, May 23, he will call attention to the Standing Orders of the House of Lords, and move amendments in Nos. 95 and 96, which are as follows:—(95) "The Chairman of Committees may, if he think fit, report to the House his opinion that any unopposed Bill on which he shall sit as Chairman shall be proceeded with as an opposed Bill." (96) "Every Local Bill or Provisional Order Confirmation Bill which is opposed shall be referred to a Select Committee of five."

THURSDAY, MAY 15.

Rawmarsh Local Board Bill,—reported, with amendments.

Birmingham Corporation Water Bill,—reported, without amendments.

The Arlecdon and Frizington Water Bill was brought from the Commons, read the first time, and referred to the Examiners.

Pemberton Local Board Bill,—read the third time, and passed.

Dudley Sewage Bill,—read the third time, passed, and sent to the Commons.

Brighton and Hove Gas Bill, Glasgow Corporation Water Bill,—read the third time, with the amendments, and passed.

FRIDAY, MAY 16.

The Nelson Local Board Bill was brought from the Commons, read the first time, and referred to the Examiners.

Bromley Gas Bill,—reported, with amendments.

Sleaford Water Bill,—read the third time, and passed.

HOUSE OF COMMONS.

MONDAY, MAY 12.

Lancaster Gas Bill.—Petition for additional provision referred to the Examiners.

Nelson Local Board Bill,—as amended, considered; two clauses added; amendments made; Bill to be read the third time.

Petitions were presented against the Gas and Water Orders Confirmation Bill (Thirsk District Water Order) from (1) Vestry of Thirsk, (2) Inhabitants, &c., of Thirsk.

Requisitions to withdraw their petitions against the following Bills were

presented:—Derby Improvement, and Plymouth and Stonehouse Gas, from the Postmaster-General; Preston Gas, from the Corporation of Preston; Stratford-upon-Avon Corporation and Local Board of Health, from the Stratford-upon-Avon Gas Company; Wisbech Gas, from the Corporation of Wisbech.

AIRE AND CALDER NAVIGATION BILL.

Mr. RAIKES reported from the Committee on the Aire and Calder Navigation Bill: "That this Bill as introduced proposed to authorize the manufacture and supply of gas and electric light to the town and port of Goole by the undertakers of the Aire and Calder Navigation; but that the promoters of the Bill had withdrawn all the provisions relating to the providing and supply of the electric light. That the existing gas-works at Goole have been in operation for many years, and have been constructed by the said undertakers out of the profits arising from their general undertaking. That the proposed additional capital of £20,000 will be provided for in the same manner, or out of moneys which the undertakers are entitled to borrow; and the dividend thereon is by the Bill limited to 5 per cent. per annum, and it is not proposed by the Bill to raise any additional share capital. That under these circumstances the requirements of Standing Order No. 188A, requiring the sale by auction or tender of the additional capital, are inapplicable."

TUESDAY, MAY 13.

Bills reported:—Colchester Water, Crystal Palace District Gas, Nottingham Corporation, Wombwell Local Board.

Knutsford Light and Water Bill.—The following special report was brought up from the Select Committee:—"That in the case of the Knutsford Light and Water Bill, which had been referred to the Chairman of Ways and Means as unopposed, the promoters of the Bill had obtained power to insert certain additional provision, and a petition had been deposited in the Private Bill Office against such additional provision." The Bill was referred back to the Committee of Selection.

Arleedon and Frizington Water Bill,—read the third time, and passed.

A petition was presented against the Gas and Water Provisional Orders Confirmation Bill (Wellingborough Gas Order, Oystermouth Water Order), from the London and North-Western Railway Company.

Requisitions to withdraw their petitions against the Morecambe Gas, and Preston Gas Bills, were presented from the London and North-Western Railway Company.

The Knutsford Light and Water, Blackpool Extension and Improvement, Leicester Corporation, Newcastle-upon-Tyne and Gateshead Gas, South Shields Gas, and Rochester Corporation Bills were referred to a Select Committee, consisting of Sir Lawrence Palk (Chairman), Mr. Blennerhassett, Mr. French, Mr. Sotheron Estcourt, and Sir John Duckworth (Referee); to meet on Tuesday, May 20.

RIVERS CONSERVANCY BILL.

Mr. HARCOURT gave notice that on the second reading of the Rivers Conservancy Bill he will move—"That any Government scheme for the prevention of floods in districts consisting of the basins of rivers, should include, either by means of a general or special Act, measures for the relief from floods of districts and towns within the watershed of the River Thames, without the Metropolitan area."

WEDNESDAY, MAY 14.

Aire and Calder Navigation Bill, Imperial Continental Gas Association Bill, Warrington Corporation Bill,—as amended, considered; to be read the third time.

Lighting by Electricity.—A petition against granting special powers was presented from the Boston Gaslight and Coke Company.

Public Health Act (1875) Amendment Bill.—A petition for alteration was presented from the South Staffordshire Water-Works Company.

Requisitions to withdraw their petitions against the following Bills were presented:—Lancaster Gas, from the Corporation of Lancaster; Stourbridge Gas, from the Great Western Railway Company; West Kent Main Sewerage (Lords), from Edward Henry Scott.

THURSDAY, MAY 15.

Nelson Local Board Bill,—read the third time, and passed.

Bills reported:—Blackburn Improvement, Over Darwen Corporation.

Lancaster Gas Bill.—The Examiners report, "That the Standing Orders have not been complied with in the case of the petition for additional provision in the Lancaster Gas Bill," was referred to the Select Committee on Standing Orders.

Gas and Water Provisional Orders Confirmation Bill.—The order for the committal of this Bill was read and discharged, and the Bill (so far as it relates to the Wellingborough Gas, Oystermouth Water, and Thirsk District Water Orders) was referred to the Committee of Selection.

Lighting by Electricity.—Petitions against were presented from Accrington Gas and Water Works Company, Cardiff Gaslight and Coke Company, Cheltenham Gaslight and Coke Company, Croydon Commercial Gas and Coke Company, Dover Gaslight Company, Durham Gas Company, Edinburgh and Leith Gaslight Company, Hartlepool Gas and Water Company, Hastings and St. Leonards Gas Company.

FRIDAY, MAY 16.

Bills reported:—Morecambe Gas, Plymouth and Stonehouse Gas, Preston Gas, Stratford-upon-Avon Corporation and Local Board of Health, Wisbech Gas.

Belfast Water Bill, Ilkley Gas Bill,—as amended, considered; to be read the third time.

Dudley Sewage Bill (Lords),—read the first time, and referred to the Examiners.

Requisitions to withdraw their petitions against the following Bills were presented:—Newcastle-upon-Tyne and Gateshead Gas, from (1) Corporation of Gateshead, (2) North-Eastern Railway Company; South Shields Gas, from (1) Corporation of Jarrow, (2) Corporation of South Shields.

The Gas and Water Provisional Orders Confirmation Bill (Wellingborough Gas, Oystermouth Water, and Thirsk District Water Orders) was referred to a Select Committee, consisting of Mr. Clifford (Chairman), Mr. Edwards, Mr. O'Neill, Mr. Finch, and Mr. Bonham-Carter (Referee); to meet on Wednesday, May 21.

SATURDAY, MAY 17.

A requisition to withdraw their petition against the Gas and Water Orders Confirmation Bill (Oystermouth Water Order) was presented from the London and North-Western Railway.

THE SELECT COMMITTEE ON LIGHTING BY ELECTRICITY.

FOURTH DAY—FRIDAY, MAY 9.

(Members present: Dr. Lyon Playfair, in the chair; Mr. Alfred Gathorne-Hardy, Mr. Hardcastle, Mr. Mitchell-Henry, Sir Ughtred Kay-Shuttleworth, Mr. Arthur Moore, Earl Percy, Mr. Puleston, Mr. Spencer-Stanhope, Mr. Christopher Talbot, and Sir David Wedderburn.)

Dr. *John Hopkinson*, examined by the CHAIRMAN.

I am a Fellow of the Royal Society, and a Doctor of Science of the University of London. I have for the last seven years been engaged in the construction of lighthouses, and, consequently, have taken great interest in the subject of electric lighting. I superintend the manufacture of lighthouse apparatus at Messrs. Chance's works. I have been making experiments in the conversion of energy into electric light, and will explain to the Committee by steps in what manner, say, 100 cubic feet of gas could be converted into electric energy. Starting with 100 cubic feet of gas burnt to produce light, the amount of light would depend upon the burner used, and upon the quality of the gas; but if you took gas worth about 15 candles per 5 cubic feet per hour, and burnt it in, say, 20 ordinary gas-burners, you might get from 100 cubic feet about 300 candles in one hour. When you burn it in that way, the whole of the energy contained in the gas is not converted into luminous radiations, as, during the combustion, the particles of carbon in the gas are at first raised to a considerable temperature, and when at that temperature they throw off radiations; but the major portion of the heat produced by the combustion will be devoted to heating the carbonic acid, the water, and the nitrogen to a greater temperature than the air and gas from which they are derived; in other words, a large part of the energy of the combustion passes off as heat. I believe there are no experiments which show what is the proportion of luminous radiations and of heat radiations produced in burning gas. It would be very desirable that such experiments should be made. In burning the 100 cubic feet of gas to obtain a 300 standard candle light, the light is very much the same in character as that of the standard candle with which it is compared; the proportions of the different colours of the spectrum are about the same. Supposing that instead of burning 100 cubic feet of gas for the purpose of producing light in the ordinary way, you burnt it in a gas-engine: if burnt in an hour you might get about 4-horse powe in the dynamometer. The makers of the machine say that you get 5 indicated horse power in the engine; but I think that if you take it at 4-horse power it will not be very far from the truth—that is to say, by the combustion of the gas, and utilizing the whole of the force, you convert it into mechanical energy, which is practically about 4-horse power. To convert that mechanical energy into an electric current, you might use the 4-horse power to drive any dynamo-electric machine. For example, it might be applied to a Siemens machine of medium size, such as was used in the Trinity House experiments at the South Foreland; and, judging by those experiments, one might expect to get a common electric light of at least 4000 candles, measured horizontally. So that the 100 cubic feet of gas, which by ordinary combustion produced a 300 standard candle light, is converted, through the medium of the electric current, into a 4000 standard candle light. The reason that there are such differences between the two cases described—that is to say, between the small amount of light produced in the ordinary combustion of the gas, and the far greater amount of light obtained when you convert it into an electric current—is due to the very much greater temperature which you cause in the case of the electric arc than in the case of the gas-burner. In the case of the gas-burner, the heat due to the combustion is devotable to heating the whole of the products of combustion; in the case of the gas-engine, a very small portion of the energy of combustion is taken away, so to speak, from the products of combustion, and is converted into mechanical energy. That, again, with a slight loss of about 10 per cent., is converted into energy and electric current; and, lastly, that, in passing through the electric arc, will have a portion of its energy converted into heat, and will intensely heat the carbons, which, being of very small dimensions, are heated to an exceedingly high temperature. They, therefore, give off radiations, and, owing to their exceedingly high temperature, a large proportion of the radiations are of such a character that they are sensible to our eyes. The dynamical economy of the electric light might almost be said to be in part an accident of our eyes; our eyes being such that we see the radiations of the electric light to a greater degree than we see the radiations of a gas-flame. But, although as a practical fact, about 13 times more light can be obtained from burning gas, and converting it into mechanical power, than by merely the ordinary mode of using gas for illumination, when you come to the question of economy, the economy in the production of electric light is certainly not at all in that ratio. In order to produce the light, you will require not only to consume the gas to give you the power, but you will consume a considerable amount of carbon. The specially prepared carbons are very expensive; indeed, the cost of the carbons will be in excess of the cost of the gas. That is to say, the amount of carbons which would be consumed in an electric light produced by 100 cubic feet of gas, would actually cost more than the gas itself, in the present state of its manufacture; but that may, of course, change any day. And in addition to that, you have to use an expensive plant for converting the gas into mechanical energy. From my scientific investigations of the subject, I do not agree with some other witnesses who have stated that the electric current when divided into various electric lights will decrease according to the squares or the cubes. I think their deductions are based upon assumptions which any one would not have the least difficulty in setting entirely aside. However, there is positively, in practical working, a loss of economy in dividing the current into several electric lights. The cause of that waste is twofold. In the first place, you have, in divided lights, generally much smaller lights than the full light; and for the reason which has been already mentioned, of the lower temperature, you will get a less proportion of radiation sensible to the eye. That point has been very well illustrated by some experiments of Captain Abney's, which were published in the proceedings of the Royal Society about a year ago. He shows that, in measuring the lights of electric arcs of different sizes, the powerful lights contain a much larger proportion of blue light than the lower ones. For example, he, I think, had in one case an electric arc which gave about 180 times as much red light as a candle, but it gave 360 times as much blue light. Then he ran the machine faster, and obtained a more powerful light; and, if I remember rightly, it was something between 2000 and 3000 times as much red light as a candle, and over 10,000 times as much blue light. Then, in the second place, I think that practically there is a difficulty in producing many lights from one machine, the attempt to get over which probably involves a loss of efficiency, and that is the difficulty of keeping them steady. Any disturbance in one of the series causes a disturbance throughout all the rest. From my close attention to the subject, I am of opinion that neither the science nor the practical application of the electric light is, at the present moment, in a very advanced state; there is room for a great deal more to be done yet. As regards the scientific consideration of the subject, it has hardly been, as yet, touched in a satisfactory manner. During the last few years, however, there has been a considerable advance made in its practical application, especially with regard to lamps. There has been a greater practical advance, as compared with what I may call the scientific advance.

By Mr. SPENCER-STANHOPE: The calculations I gave with respect to the conversion of the energy of the gas into electric light were based upon the production of one electric light only, so that what I have said as to the loss of lighting power by subdivision would undoubtedly apply in still further reduction of the power gained by present methods.

Sir DAVID WEDDERBURN: In describing the method in which 100 cubic feet of gas could be converted into a proportionate amount of electric light, I should like you to mention in what way you consider that gas is more advantageously available for that purpose than would be the coal from which the gas had been originally manufactured?

Witness: I do not think that it is so. The reason why I selected gas was that, in that case, I could get an immediate and direct comparison. I could take 100 cubic feet of gas which could be, and was, daily used for producing light, and I could show that, by using it for producing an electric current, a great deal more light could be produced than if it were burnt directly in gas-burners. The whole of the energy in that case, with its losses at each stage, could be traced.

Then I suppose that, so far as economy is concerned, coal would be a better thing to use than gas for working the machine of which you speak? —Undoubtedly it would, except in this one respect, that a steam-engine always requires a man to look after it, whereas a gas-engine may be allowed to run without any supervision.

By Sir U. KAY-SHUTTLEWORTH: If I compared the coal which produces the gas with the coal used in the engine for producing the electric light, the results would certainly be more to the advantage of the electric light than if I compared the electric light produced by a gas-engine with the light which would have been produced by the gas used in that engine.

By Mr. MITCHELL-HENRY: We have not done anything at Messrs. Chance's works to diminish the noise in using the Siemens lamp; it has not been an inconvenience for our purpose. Of course, one has observed it, and likewise that the light is very variable; that occasionally one would get a perfectly steady light for a considerable length of time, and then it would become unsteady, and produce an amount of hissing that would be very disagreeable in a quiet room. There is a considerable variation in the carbons; some are very much more satisfactory than others. Undoubtedly, the light depends, in some cases and to some extent, upon the manufacture of the carbon itself.

By the CHAIRMAN: I have sometimes noticed that in our works the hissing noise of the electric lamps is practically found only when it first starts, and that, after it has been started some time, no practical inconvenience is experienced; but at other times we have failed to get rid of the hissing, and it has recurred frequently during the whole time we have been at work. I have always attributed it to bad adjustment of the lamps.

Mr. SPENCER-STANHOPE: In comparing the work done by a gas-engine and a steam-engine for producing the electric light, did you give us a comparison between the loss incurred by using coal in producing steam for that power, and the loss incurred in using coal for producing coal gas for that power? Has that been worked out?

Witness: I have not stated that here, but I have worked out some figures which show the steps and the losses which occur in the conversion either of coal into energy or of gas into energy.

I mean starting from the coal itself to the electric light. You lose a good deal in converting water into steam, and you also lose in converting coal into gas?—A ton of the coal which is generally used will, I suppose, give about 9000 or 10,000 cubic feet of gas.

You have to heat the coal?—Yes; but then, on the other hand, you have the waste products, which are of great value. I have looked at it rather in this way—that, taking the gas on the one hand, the energy or the heat of combustion of 100 cubic feet would have a mechanical equivalent of about 24-horse power working for one hour, if it were all converted into mechanical power; but we actually get about 4-horse power of that, and it would be impossible, working within ordinary temperature, to get more. It can be proved to be physically impossible. I may, perhaps, take a step further than that. We actually get 4-horse power, and less than half of that is actually changed into heat in the arc itself, the rest being changed into heat in the conducting wire. So that actually of heat, worth 24-horse power for an hour, we get 2-horse power for an hour, changed into heat in the arc. If we look at it from that point of view, and if we were actually to obtain heat in the arc equivalent to the 24-horse power, which is the equivalent of the 100 cubic feet of gas, we should get 50,000 candles as against 300 candles. This brings out in a strong light that the efficiency of the electric arc is not due to the perfection with which we devote the energy of the gas to heating the arc, but to the fact that the energy is of such a kind, that we can see it. On the other hand, I made a calculation as regards anthracite coal, that 100 cubic feet of gas may be said, in heating effect, to be equal to about 4½ lbs. of coal, and consequently, a gas-engine giving 4-horse power for 100 cubic feet is a very much more efficient engine, looked at from a dynamical point of view, than almost any steam-engine which has ever been constructed.

Mons. *Jules Albert Berly*, examined by the CHAIRMAN.

I am a Civil Engineer, and am now in charge of the English works of the Société Générale d'Électricité. That society has been in operation in England twelve months. On the Thames Embankment we have been working 20 lights for the last five months, extending from Westminster Bridge up to Waterloo Bridge. The distance between the two extreme lights is about 1100 yards. The lights are mostly in opal globes, part in frosted globes. The duration of the lighting has been, on an average, about five hours per night, without intermission. The lights are placed on the river parapet, as a rule, on every alternate gas standard, so as to utilize the present fittings. The steam-engine is 20 nominal horse power, and we drive through an intermediate shaft a battery of Gramme machines composed of two machines, one giving a continuous current of electricity, and exciting a larger machine which gives an alternate current. The reason why we use an alternate current in connection with our candle is that a continuous current would cause one of the carbons to burn much more quickly than the other; and in order to consume them at the same speed we use an alternate current. The current is alternating at the rate of about 80 times per second, in order to produce an equality. The current from the Gramme machines is conveyed to the candle through tinned copper wire. The distributing Gramme machine feeds 20 lights, divided into four circuits, upon each of which five lights are placed. Each circuit is composed of a continuous wire, starting from the machine and coming back to the machine. On this continuous wire five lamps are placed. The current passes up the candle and down again to a return wire, which is common to all the four candles. It comes back through the return wire, and another wire leads the current to another candle. The same thing happens to the five lamps placed in the same circuit, and, lastly, the commutator has a wire going back to the machine. The candles last an hour and a half; at the end of that time a man must go round, and, with the commutator, switch the current to the next candle. In the case of the Embankment, the commutator is attached to the candle-holder itself, and the man must go up to the lamp and switch it from underneath. In some instances the commutators are placed in the lamp-posts themselves, or in any position where the man can reach them. In the extension that we are preparing on the Embankment, the switching will be done from a distance; the man will switch the whole of the lights from Westminster to Blackfriars from the engine-room at Waterloo. With the engine on the Embankment we at first worked 20 lights. We are now putting another 20, which we have tried experimentally, and which we know will work. I have no doubt that another 20 could be added to it, and perhaps more. Until now we have worked the engine up to 50 lbs. pressure, but it can be worked at 80 lbs. About the power of the light there is great contention. It is estimated, I think, in different ways. Mr. Keates, the Chemist of the Metropolitan Board of Works, has carried out a very minute series of photometrical experiments. I intended to follow his experiments, which were very interesting to me, but at the time he was carrying them out I was very busy at the British Museum, fitting up the light for the Trustees of that Institution, so that I do not know what the results are. Our contract with the Metropolitan Board of Works is 5d. per hour per light, including everything, less the hire of the steam-engine. That leaves a fair profit to the Société. Of course, that cost might be very much reduced by adding additional light to the same engine and to the same centre. From the same centre we could produce any number of lights with a more powerful steam-engine and with a large battery of Gramme machines. This calculation of 5d. per hour is based upon a duration of the lights for five hours a day. If the motive power was used constantly, either for light or for other purposes, the cost might be materially reduced, and I am certain that if hydraulic power were applied it would still further reduce the cost. I carried out the experiments on the Holborn Viaduct. We had 16 lights there, extending from Holborn Circus to Newgate Prison. They were exactly on the same principle as those on the Thames Embankment. We charged £5 per night for the whole 16 lights, burning from sunset to midnight. This price, of course, was understood to be only for an experiment, and for a contract of very short duration. We undertook the lighting of the Holborn Viaduct in the early days of the working of our system. At the Embankment we have never had any irregularity in the working of the light; but we had some irregularity at the Holborn Viaduct, which was due, I think, to our French workmen occasionally getting intoxicated through being treated. That experiment did not produce a very favourable impression upon the authorities, and it was abandoned. In practice there is no reason why there should be any irregularity in the working; in fact, we have proved it on the Embankment, where we have worked every evening for five months without any interruption at all. There was another instance at Billingsgate Market, which I had to do with. At first we had 16 lights there, distributed all over the building. The reason of the failure was, that the market itself was not sufficiently lighted. The light was not found to please the fish salesmen, owing to its colour, which did not prove very favourable to the fish, I think, and owing also to its want of warmth. Four more lights were afterwards added, and some of the lights which were distributed in the other buildings were brought down, in order to give more light in that central hall. But it was shortly afterwards decided that the electric light should be discontinued. We had a rather complicated arrangement of charge for the light at the market. They provided the motive power themselves, while we charged for the plant, and also for the Jablochkoff candles consumed, at the rate of 8d each; so that it was rather a complicated arrangement. In the British Museum reading-room we had 12 lights, 1 in the hall, and 1 in the entrance, making 14 altogether. There has been a series of private trials there, at which the officials of the British Museum, and several persons invited, assisted. The public experiments lasted only three days; they could not be carried on much longer, and there was no necessity, as the effect had been ascertained; and also keeping open the Museum entailed a rather large expenditure. For three consecutive evenings the reading-room was open to frequenters, who expressed themselves as very satisfied; and so did, I think, the Trustees of the Institution. Captain Shaw, of the Metropolitan Fire Brigade, who was asked to inspect the plant, and give his opinion about the freedom from danger, expressed himself as perfectly satisfied that there was not any danger. It has as yet been merely an experiment. The British Museum authorities are, however, going to try various systems to find out which is the best, and I think that next season there will be some further trials. We introduced our system at Messrs. Shoolbred's, in Tottenham Court Road, as far back as last Christmas. They began with 6 lights, and I think they extended it to 16, and then to 20, and they have now 25. It is there used in conjunction with gas. We have also applied it at the large ironfoundry of Wells and Co., in Shoreditch. I am actually fitting it up at Messrs. Cocker and Sons, in Friday Street, in the City; in fact, last night I tried it, and I think next Tuesday we shall have an official trial; there will be 20 lights in the large warehouse. We have also 40 lights burning at the Lower Aston Pleasure Grounds at Birmingham. In my experience, I find that the demand for the electric light is slowly and surely increasing.

By Mr. SPENCER-STANHOPE: The carbons were sold at 7½d. each when we first introduced the system into England. On the 1st of February the price was lowered to 6d. for each candle, and from the 1st of this month we have sold them at 5d. each. They last one hour and a half, and therefore the cost is 3⅓d. per hour per lamp for the carbon itself. Our new contract with the Metropolitan Board is for 40 lights, at 5d. per hour. For 60 lights we might perhaps be able to make a further reduction. So far as we have experimented, we have not found that the length of the conductors and the distance apart of the lamps affect the amount of the light. I do not think there would be any difficulty at all in lighting a circle with a radius of one mile and a half, or perhaps more. Of course we are finding out every day new things which astonish us more or less, and which are not exactly in accordance with theory.

By Mr. HARDCASTLE: In the shop of Mr. Shoolbred, to which I referred, the lights are placed 10 in the shop, 10 in the show-room, and 5 in the basement. I think Captain Shaw was perfectly satisfied that there was no danger at all from the lights. Sparks do not fall off in the course of burning, if the precaution is taken of enclosing the lights in globes. We do not burn our lights naked, and we can arrange the globes so that there can be no possible exit for any sparks. That precaution, of course, we took at the British Museum. There is not any hissing noise at all made by the candles; there is a humming noise, which is scarcely perceptible. This is caused by the passage of the electric arc from one carbon to the other, and it is magnified by our globes which are sonorous; but it is scarcely perceptible. In the experiment on the Embankment, we at first worked the engine at 70 lbs. pressure; but I told the driver to let the pressure go down gradually to 50 lbs., and we found that that drove the 40 lights easily.

By Sir DAVID WEDDERBURN: The sparks which come from the carbons when they are burning are very minute, and they only fly off at the moment of lighting. When the candle is burning there are none at all. I have explained that by closing the globe, nothing can come out of it, so that it is perfectly safe. But even supposing that a globe were not closed, the sparks are so minute that they would hardly set anything on fire; besides, they would be extinguished before reaching the ground.

By Mr. MITCHELL-HENRY: Our carbon candles are made, by pressure in a mould, in sticks of one mètre in length, and then they are cut into four parts, two of which constitute a candle. Each candle is about 25 centimètres long, that is a quarter of a mètre. The stick is first cut in two, and then each half is cut in two again. A longer candle would burn more than an hour and a half, but then the resistance of the current would be too great. I think we shall obtain, as Mons. Vivarez will explain to you, a longer consumption by using larger carbons. Mons. Vivarez will tell you that he has experimentally tried some candles which will last 2½ hours, and there would be no difficulty about making them last 3 hours. They would be the same length, but thicker.

By Sir U. KAY-SHUTTLEWORTH: The resistance is very great when we begin with a new candle, but when it has burnt down nearly to the bottom we get the best light. There would be another difficulty in lengthening the Jablochkoff candle, that we should sometimes have the light at a very

great height, and sometimes quite at the bottom of the lamp. With a large machine we have as many as five lamps for each circuit; but with a small-sized machine only two, or three, or four. There are four dimensions of Gramme machines used now, and some larger ones are being made; the smallest one feeds four lights; it is divided into two circuits of two lights each. On the Thames Embankment, we have five on each circuit, and there are four circuits, making 20 lamps altogether. We have two Gramme machines, one of which produces a continuous current of electricity, and excites a large machine, which produces alternate currents of electricity. The alternate current machine is divided into four circuits, each of which feeds five lamps. Experimentally, I think, we have used a mile and a half of wire, but practically one mile; that is to say, for the distance from Charing Cross to Blackfriars. We have not found any difficulty whatever in using that length of wine. There is certainly a great loss of light through the opal globe. The Société are trying, and have been trying for a very long time, nearly every description of globes. We are now making for the Embankment some globes, the lower half of which will be opal, and the top half plain glass, in order to throw the light on a reflector, and bring it down on the footway. I think the loss of light in using opal frames is from 40 to 50 per cent. At all events, as our light cannot be used naked, because it would be painful to the eye, a globe of some kind has to be used. A plain glass globe could not be used, as it would be equivalent to a naked light; so that we had the choice between ground or frosted glass and opal. We use frosted glass occasionally. To ground glass we have an objection, especially in this climate, as it does not keep very clean. The opal globe is convenient, because it can be washed easily, and it also diffuses the light very well. There is no difficulty in opening the globe and replacing a candle while the light is burning. We have occasionally had to do that. For instance, at Birmingham, last winter, we lighted the Town Hall for about a fortnight, and once, on the occasion of a *conversazione*, in January, we kept the lights burning for about 14 hours—from four o'clock in the afternoon till about six o'clock next morning. We had the ordinary description of candle holder; but, of course, had to fill them from time to time every six hours—that is to say, once or twice. There is no difficulty about doing that.

By Mr. PULESTON: I said just now that our contract for lighting the Holborn Viaduct was £5 a night, and that it was only an experiment. If done regularly, it would be profitable at a much reduced rate. We offered the Commissioners of Sewers to do it for half the amount. Of course, it is very difficult to say what would be dearer than gas. If an experiment in gas lighting were carried out on the same scale as we are now carrying out our experiments in electric lighting, gas would prove much dearer. The experiment on the Holborn Viaduct, so far as the amount of light was concerned, I think was very satisfactory. Supposing that we had a contract to light the whole City of London, I think the number of stations we should require would be about four, perhaps less, in the centre, for distributing. That would cover the whole area. We shall know shortly, when we have occasion to try the new lights which we are fitting on the Thames Embankment. Of course, if we had a chance of doing the thing on a large scale, we should organize it administratively, the same as gas companies are organized.

By the CHAIRMAN: If we succeed in making thicker candles, we shall diminish the amount of apparatus required for each lamp, and in that way produce simplicity and economy.

Mons. *Emile Henri Vivarez*, examined by the CHAIRMAN (through an interpreter).

I am the General Engineer to the Société Générale d'Electricité. The electric light has been produced in Paris successively by various machines. First, the Alliance machine was used; then the Gramme machine; and, in fact, every kind of machine, giving alternate currents, can be used in connection with the Jablochkoff candle. Alternate currents are required for the Jablochkoff candle, in order to consume the two sticks of carbon at uniform speed. That could be obviated by making the two carbons of different sizes, one about double the other. The electric current can be conveyed to any distance. It is only a question of the dimension of the cable; and if I had to convey an electric current to a great distance, instead of using a cable of the size now used, I should use a cable perhaps three, four, or ten times larger. We have experimented with a length of wire of about 4000 mètres, or 2½ miles, obtaining very good results. The Société Générale have carried out some experiments on the intensity of the electric light, and the most recent of those experiments have shown them that one Jablochkoff candle, burning naked, gives a light equal in intensity to 50 gas lights, each consuming 5 cubic feet of gas per hour. I am speaking now of the Paris type of gas-burner. Each of those gas lights, consuming 5 cubic feet, corresponds to 1·1 Carcel light, and each Carcel light corresponds to about 9·6 English candles. When, instead of using the naked light, one of our opal globes is put on the light, the light is reduced by about 50 per cent. We do not always use opal globes; but we also use some others—for instance, the frosted glass globes. On the *façade* of the Grand Opéra, at Paris, three lamps on one side are provided with opal globes, and three lamps on the other side are provided with transparent globes. The frosted glass globes are transparent, but not sufficiently so to let you see the luminous point inside the globes. The difference in the lighting of the two places is very appreciable, and is very much to the advantage of the side on which the transparent globes are used. The intensity of the light can be varied in many ways. For instance, instead of putting five lamps in one circuit, a larger Jablochkoff candle might be constructed to give only one light, which would be much more powerful. Also smaller candles might be manufactured, and a larger number put in the same circuit. Of course, the intensity would vary in these various cases. In Paris there has been a competition between gas and electric lighting. The Société Générale were at first authorized to put 6 lights on the Place de l'Opéra, and afterwards 8 more, making 14. As the Exhibition was going to open, the Société were authorized to light the whole of the Avenue and Place de l'Opéra, also the Place du Théâtre Français, and to add a certain number of lights on the Place de la Bastille, and at the central markets, known as the Halles Centrales. They also authorized the Compagnie Parisienne de Gaz to light with improved gas lights the Rue du Quatre Septembre and the Place du Château d'Eau, also one of the pavilions of the central markets. It was a competition trial between gas and the electric light. About a fortnight after we had been authorized to light these various places, the whole of them were lighted with the electric light. The first experiment made by the Paris Gas Company only took place about 10 days ago. The Avenue de l'Opéra is a large thoroughfare, the length of which is about 700 mètres, which would be about 770 yards. There are 32 electric foci placed alternately on each side, at about 44 yards distance. The price in the contract is 30 centimes, or about 3d. per hour per lamp. The Gas Company have lighted the Rue du Quatre Septembre, which is narrower than the Avenue de l'Opéra, with 62 lights, on a new system, which is simply a lamp with seven ordinary burners concentrated, thereby giving an excess of consumption, but no improvement in the way of using the gas. As to the result, if two lengths of thoroughfare of 100 mètres long are compared, it is found that in the Rue du Quatre Septembre, which is lighted by gas, the cost is 1 fr. 39 c.; and for the same length of thoroughfare in the Avenue de l'Opéra the cost is 75 c. only, thereby showing an economy in favour of the electric light of about 50 per cent. The Société Générale have the entire charge of the whole plant for the electric lamps at that price. In the case of the gas, the Municipality have to pay for keeping the plant in working order, and for lighting and extinguishing the lamps, and they get the gas at half the price at which it is sold to the consumer. As to the lighting power, and the amount of light in these two thoroughfares, there is a slight advantage in favour of electricity, which is estimated at about 2 per cent.; but in this last calculation we have not taken into account the comparative width of both streets. The Avenue de l'Opéra is larger, and if it were brought to the same width as the Rue du Quatre Septembre, it would show a little more than 2 per cent. in favour of the electric light. The light given by 32 electric foci in the Avenue de l'Opéra is about equal to the light given by the 62 improved gas lights in the Rue du Quatre Septembre; but the cost is 50 per cent. in favour of electricity, while the width of the street is against the electric light. The improved gas lights are used in transparent globes, the effect of which is that the flickering is so great that it is tiring to the eye. In fact, at the beginning of the electric lighting, it was a reproach to the electric light that it was a little flickery, but it is now a rest to the eye to pass from the Rue du Quatre Septembre to the Avenue de l'Opéra. A very much more economical way of obtaining light from the electric lamps would be to use more transparent globes; and it is intended to use those frosted glass globes which have been already described, thereby obtaining a larger amount of light. The duration of the contract is for one year, and the price applies to the whole year. The profits from it are not what we should call normal profits, because we are obliged to favour the Municipality; but we do not lose by the contract. The Société Générale was established on the 15th of March, 1878. In the first balance-sheet, which was made out at the end of the year 1878, the Société had written off the price of half their plant; and there was the shareholders 10 francs per share (125 francs paid up), *plus* interest at 6 per cent. The shares are nominally 500 francs, or £20, but there are only 125 francs paid up on them. That shows we paid 14 per cent., and wrote off half the value of our machinery in the first nine months. The value of the material written off would be about £16,000. The cost of the whole materials would be about double that—namely, £32,000. Half of all the preliminary expenses of the formation of the Société, and of the patents and everything, has also been written off. The capital of the Society is £300,000, or 7,500,000 francs, and one-forth is paid up. In addition to the capital, we have a certain amount of what are called B shares, or patentees shares, which also receive a dividend. There are 15,000 B shares, and 15,000 ordinary shares, one-fourth of which has been paid up, and these 30,000 shares all receive 10 francs profit per share. The 15,000 last named—that is to say, the A shares—received, besides, 6 per cent. upon 125 francs, which is the amount paid up. Of the profit made, during the nine months, 10 per cent. went to the reserve-fund. The French law obliges the Société to put 10 per cent. aside for that purpose. The remainder was used in the following manner:—To write off all the preliminary expenses and half of the plant. Then 6 per cent. was paid to the 15,000 A shares. Then a dividend was paid to the 30,000 shares at the rate of 10 francs for each share. Then there remained 20,000 francs which could not be divided between 30,000 shares, and which were carried on to the next balance-sheet. The advantages of the Jablochkoff system of electric lighting over the other systems—that is to say, over what is known as the regulator, for instance—are: The light is steady; it can be divided, which is not the case with the regulator; it is also noiseless; with the Jablochkoff candle it can also be made smaller than the light from a regulator of the same power can be made, by reducing the number of lights in one circuit, and increasing the size of the carbons; in fact, it can be brought to exactly the same power by using larger candles instead of smaller ones. If the divisibility of the light were carried too far, there would certainly be a loss; but the loss which would arise from divisibility is, I think, largely compensated by the insulation between the two pencils of carbon, which increases the light in a large proportion when the insulation is burning itself between the points. The divisibility is not limited with the Jablochkoff system, but we find it convenient to limit it to a moderate number of lights. The use of the electric light is extending itself to a great degree. In Paris there are about 500 distinct electric lamps burning; in the remainder of France about 250; and in foreign countries about 800. This has taken place in the course of one year. Nearly all countries are using it, more or less. They are using it in this country, in Germany, Spain, Portugal, and in America, and even His Majesty the Shah of Persia is using it.

The CHAIRMAN: Then you do not agree, I presume, with the evidence which has been given us by Dr. Siemens and others, that a single electric light for each machine is by far the most economical method of producing the electric light, and that divided lights produce great waste?

Witness: With the Jablochkoff system we have the choice of the two. We may produce a very great light by using larger carbons, as I have already explained, and we can also divide the light. We prefer dividing it, for this reason—that where a very powerful light is used, to take it out of the line of vision it must be placed in a very high position. It is a well-known law of physics that light loses its intensity in the ratio of the square of the distance, so that they can only get a small proportion of the light where it is wanted.

The practical economical result is achieved, that if there is a great waste in division, the waste is not sufficiently great to prevent your getting dividends?—Quite so.

Supposing you have one central light worth 1000 Carcel lamps, and you divide that into five, what light can you get out of your five?—Without insulation I think there would be a loss; but with insulation, which causes an increase of light, the total amount of the divided light is equal to the powerful light itself without being divided. This is the result of experiments made on a small scale.

However, you do not agree with the witnesses who have stated to us that the division causes a loss according to the squares, or according to the cubes of the division?—Not at all.

By Mr. PULESTON: Supposing a street were exclusively lighted by the electric light, the street might be left in darkness; but such a contingency has never happened, and there is no more likelihood of an engine breaking down than there is of a gas-pipe bursting. It is possible, though it is not probable. The electric light on the Thames Embankment is certainly costly, as compared with the quantity of light which existed before; but if there was an attempt made to give the same light by means of gas it would certainly prove more costly. The cost is 5d. here as against 3d. in Paris, but the expenses of illumination in London are greater than in Paris, because the Société are not established in London, and everything is more costly when the work is done in London than when it is done in Paris. The more extended the duration of the contract, of course the more reduced prices we could afford to work at. The shares of the Société, on which £5 are paid up, are now worth within a few shillings of £27 in the Paris market.

By Mr. ARTHUR MOORE: I think that it would be as cheap to have five lights, say, of 1000 candles each, as to have one light of 5000 candles. That is my general impression, but I could not say exactly from figures.

By Mr. HARDCASTLE: The Société, having their seat in Paris, can

afford to light at a cheaper rate than in London, where there are heavy expenses. For instance, all the material has to be sent from France, and the cost of transit and package, and so on, is very considerable. If they were established in London as well as in Paris, they would be able to produce the light at the same price, and if the area of the work were largely extended in the way of public street lighting, the price could be still further materially reduced. For example, the carbon pencils, which at the creation of the Société cost as much as 30,000 frs. per ton—which was a ridiculous price—now cost 5000 frs. per ton, and I still think that is much too high. There is no doubt, if the product were increased, the cost would decrease accordingly. Actually, there are 100,000 mètres of carbon used per month. At the Magasins du Louvre, in Paris, there are 84 electric foci maintained from one steam-engine; which is the largest number which has yet been obtained from one centre.

By Sir DAVID WEDDERBURN: The gas is lighted in Paris when the electric light is put out. It is evident that the divisibility of the light was a desideratum for a long time. It is acknowledged that it is an advantage, and as such it must be paid for. If you push the divisibility too far it will be too costly. The Société have, in using the Jablochkoff system, aimed at obtaining, by dividing the light to a certain extent, the same amount of light as they would have obtained from one more powerful light. It is evident that the users of a single powerful light are limited, and it is a fact that the Magasins du Louvre would never have been lighted by means of a single light. The divisibility of the light, as used at the Magasins du Louvre, causes an economy, and, since it causes an economy, it constitutes a great advantage for the proprietary of those Magasins.

Sir U. KAY-SHUTTLEWORTH: What is the lowest candle power light which can be economically produced with the Jablochkoff candle by division?

Witness: I cannot give the exact amount, because we have confined ourselves to one type and size of candle; but I think that from 50 Carcels, which is the actual alleged power of the light, it might be brought down to 7. The Société now employ lights all of the same type and size, equal to 50 gas-burners, consuming 5 cubic feet each. That is the naked light.

Mr. PULESTON: It was stated, I think, some time ago, that the Société paid a very large sum indeed—something like £100,000 or £200,000, if not more—for the use of the Jablochkoff patents—have you any objection to say on what principle the cost of using those patents is calculated?

Witness: Mons. Jablochkoff is now one of the Directors of the Société, and he took some of the B shares.

Is it not possible that some of your very profitable results may be attributable to what may be called a temporary use of the electric light, which is adopted, as all new things are adopted, to a large extent perhaps by way of advertisement, and so on, because it is used rather as a novelty than as a matter of permanent practical utility?—On the contrary, I think people are generally more prejudiced and guarded against novelty than otherwise. It proves economical in other ways also. The absence of heat in the electric light causes ventilation not to be required to the same extent as where gas is used, which is an indirect advantage of the electric light over gas. Very shortly the Théâtre du Châtelet will be lighted entirely by means of the electric light. It has been used for about two years, and it is to be extended to the auditorium.

Mr. A. GATHORNE-HARDY: Is there not an objection to this light, that if you divide it you cannot put out one of the lights with any economy of motive power?

Witness: I cannot take upon myself to say that every advantage belongs to the electric light. The electric light has certainly its advantages, but it may have also its inconveniences. The question is, whether the advantage compensates for the inconvenience. No doubt, as a matter of fact, the electric light has that disadvantage.

Mr. ARTHUR MOORE: Has the proprietor of the Magasins du Louvre made any estimate regarding the cost as compared with gas?

Witness: Yes; Mons. Germain, a member of the Institut Français, gave a lecture at the Sorbonne, about six months ago, and, from inquiries made by himself at the Louvre establishment, he said he was justified in saying the saving by using the electric light amounted to 33 per cent.

By Mr. MITCHELL-HENRY: We have not lighted, or attempted to light, by the electric light, any other fish market than Billingsgate. I am not able to say whether the complaint of the electric light not enabling fish salesmen to judge of the quality of the fish is well founded.

Mr. *Frederick Shoolbred*, examined by the CHAIRMAN.

I am a partner in the firm of Shoolbred and Co. We introduced the Jablochkoff system of lighting into our establishment the first week in last December. At first we had five lights, but have since increased the number to twenty. We have discontinued the use of 230 gas-burners, mostly Argands, since the 20 electric lamps have been used. We had very little trouble in the introduction of the new light. The lights all went out once; but it was our own fault. The band slipped off the engine, and the engine came to a stop. That discontinuance was not such an inconvenience as to prevent us going on with the light. The light is infinitely better than gaslight; in fact, it is very nearly equal to daylight. It gives very nearly the same colour on the goods as a bright summer's day. The atmosphere in the shop since using the lights is very different—much better. We used to get so very hot. The electric light has no effect at all upon our goods; whereas gas perished them to a considerable extent. Colours are perfect by the light, and that is a great advantage in our business. Our customers are able to match colours at night, and we can match them ourselves. At one time, directly the gas was lighted, we had to give up all matching orders or post orders; but now we can go on, if we choose, by the electric light. In regard to cleanliness, I think there is a great advantage in the electric light that it does not blacken the ceilings and the fixtures up high that would get blackened by gas. It does not blacken our goods. Any that were high up would get blackened by the gas, and would be perished by the heat. We have had some experience of foggy days; and the electric light has appeared to clear the fog away. All those foggy days in the winter we were wonderfully clear, and we were certainly independent of the fog. With gas we were absolutely shut up, because the gas appears to draw the fog into the building, and it was so foggy that we could do nothing; but this light appeared to have the opposite effect—the fog seemed to go. All those foggy days, when it was pitch dark outside, you saw apparently no sign of fog in our place. As to the disadvantages of the electric light, it flickers at times, and turns red, if the carbons are not perfect in quality, and that sometimes will continue with one candle, more or less, all the way through it. If our man does not regulate the motion of his steam-engine with care, we have an irregularity in the amount of light. It seems to me to depend entirely upon the engine. Unless the engine is worked regularly and well, you could not succeed with the light at all. I think it is a drawback, being dependent on any one being sufficiently punctual to change the candles every hour and a half. I have myself had to run after them occasionally. However, I consider that the advantage of the electric light in our establishment considerably outweighs the disadvantages, and we are therefore continuing it. We have 25 Jablochkoff candles, but only a Gramme machine that will work 20 at a time at present. It costs £1749 to lay down the plant for 20 candles, but that did not include the boilers. We had sufficient boiler power already, or, at least, nearly sufficient; we had merely to add to the boiler power. The 20-light Gramme machine cost £440, a 6-horse power engine and fittings cost £479, and lamps, wire, fittings, and connections for 25 lights cost £830. That includes all the labour, working, and everything. Therefore, for £1750, *minus* the boilers, we laid down our plant. As to working expenses, the candles burn an hour and a half, and cost 6d. each. You can hardly say they will burn for an hour and a half; there is always a waste, more or less, and they do not burn very regularly; so that we have put the cost down at 5d. per hour for each candle, and the coal, water, oil, wages, and so on, at 1½d. I think that is a very liberal reckoning; it does not cost us more. The daily expenses are greater in winter than in summer. The winter average cost of the 20 lights is about 37s. or 37s. 3d. per day; the summer averages a little under 9s.—I think it is 8s. 10d. As compared with gas, I think it must be more expensive, and in practice it has been infinitely more expensive, for we have had to pay as much for gas. That may be because, accustoming the eyes to a very powerful light, as you do with the electric candle, our *employés* are not satisfied with the much poorer gaslight in other parts, and burn a great deal more gas. There may be something in that; I dare say there is a good deal in it.

By Mr. PULESTON: The electric light has no effect whatever upon the eyes. Some few of the ladies who visit our shop complain of the effect upon their complexions. I think, perhaps, it is hardly fair to speak of the increase in our consumption of gas, without mentioning that we have used a great deal of gas for cooking. We have several very large stoves for cooking, and even additional ones since the use of the electric light. The flickering is not constant; sometimes the lights burn perfectly well for days and days together. The variation is owing to the carbons, and to the unsteady working of the engine. There is no appreciable noise, except occasionally when an imperfect candle makes a little buzzing.

By Earl PERCY: The flickering is not sufficient to be a serious inconvenience. When the flickering is owing to the steam-engine, all the candles flicker.

Mr. MITCHELL-HENRY: With regard to the gas, if you have discontinued using 230 Argand burners, of course there must be a saving in the consumption of gas, and, therefore, it must require only a calculation as to how much you save. If you take this £1750, which is the total expense of your apparatus for electric lighting, at 6 per cent., it comes to £105 a year as the total expense, according to your idea of everything, except attendance; and £105 per annum would go a very short way, it appears to me, in supplying gas to 230 Argand burners?

Witness: Yes; but then there is the expense of the candle all the time as well.

Then you have to add to the £105 the working expenses?—Yes, and you might fairly deduct part of that £105, too, because the engine does not stand idle all day. Although we had to put it up in addition, not having sufficient spare engine power, still we make use of it in the daytime for other purposes.

By Mr. PULESTON: We have not any reflectors over the Jablochkoff lights; and we have not succeeded in getting one that would answer. The best we find is a white ceiling. The nearer it is to a white ceiling, the better the light we appear to get from it. From what I have been informed, they tried several with us, but they never obtained one that appeared to do much good.

FIFTH DAY—TUESDAY, MAY 13.

(Members present: Dr. Lyon Playfair, in the chair; Mr. Alfred Gathorne-Hardy, Mr. Hardcastle, Mr. Mitchell-Henry, Lord Lindsay, Mr. Arthur Moore, Earl Percy, Mr. Puleston, Mr. Christopher Talbot, and Sir David Wedderburn.)

Mr. *George Frederick Deacon*, examined by the CHAIRMAN.

I am a Member of the Institution of Civil Engineers, a Member of the Institute of Mechanical Engineers, and Borough Engineer of Liverpool, with which office is associated that of Inspector of Gas Lighting. I have paid special attention to the application of electricity to useful purposes. I was at one time professionally engaged exclusively in electrical work as the assistant to Sir William Thompson during the time he was Consulting Electrician to the Atlantic Telegraph Company in 1864 and 1865. I accompanied the *Great Eastern* as one of the professional assistants of the Atlantic Telegraph Company. In my capacity as Inspector of Gas Lighting for the Borough of Liverpool, I have paid considerable attention to the lighting of streets and public institutions. I have in that capacity had to consider the comparative advantages of small lights and large lights for public purposes, and it is a subject to which I have given considerable personal attention. I went, on the part of the Corporation of Liverpool, to Paris, to examine into the system of lighting by electricity in use in that city in the autumn of last year. I paid special attention to the lamps, or regulators, which are used for the purpose of producing electric lighting, and I found that the mode in which the light was obtained at the lamp affects the question in a very high degree. If we take the Avenue de l'Opéra in Paris, for example, the result is very unfavourable to the electric light. In the first place, I found that in the Avenue de l'Opéra the Jablochkoff candles, as shown there, are not done justice to, because they are placed so unequally. In some places the light is very much more intense than in others, and, therefore, measured according to the method which I adopt for street lighting, it comes out very unfavourably. There are 32 lamps which give a light of 172 candles each, or together 5504 candles, which, at 7·68d., gives £10s. 5¼d. I found that to give almost exactly the same light (taking into consideration the irregular distribution of the electric light, and distributing the gas-jets irregularly also) 165 gas-jets would be required; giving, after allowing for the absorption of light by the clear glass, 14·08 candles each, or a total of 2323 candles, costing 0·243d., or in all 3s. 4d. But if I take the 32 Jablochkoff lights, and place them in the most economical position in the Avenue, I find that it will require 250 gas-jets instead of 165 to produce the same amount of illumination as before, and the total cost will be 5s. 0¾d. That shows in the first case a ratio of six to one in favour of gas, but in the second case of only four to one; that difference being wholly due to the better placing of the lights. The Avenue de l'Opéra is exceptionally well suited for the exhibition of the electric lights, and not well suited for gas lights, its width being very great; and I find that if the absolute intensity of the light is reduced to an ordinary standard, the result comes out very differently. Bringing down the electrical illumination to an ordinary standard, I find that we should require 8 electric lights of the same kind, costing 5s. 1½d.; and 40 gas lights of the same kind, costing 9½d. This again gives a ratio of 6·5 to 1, making it rather worse for the electric light than in the first case, in which it was badly placed, and a great deal worse than in the second case, in which it was well placed. If I made the comparison with regard to the units of light, there would be a very different result—much more favourable to the electric light. In that case the electric light would be as cheap as, or cheaper than gas. A concentrated light of 1000 candles, or more, would be cheaper than gas. In considering the future of the electric light, it should be remembered that it may be more suitable than gas in some instances, and less suitable in others. It is wrong to compare two lights of different intensities by candle power, by any unity of light, at a given distance. If we were to measure all kinds of lights in the same way, by mere candle power, we should find that candles, or rushlights, would be from 10 to 20 times more expensive than gas, and from 30 to 100 times

more expensive than electricity, which, of course, is absurd. Various kinds of lighting are suitable under different circumstances. The question of cost per unit of light is not the only one which has to be considered; the question of adaptability must also be taken into account. I am satisfied that the best treatment is not given to the electric light; for instance, covering the Jablochkoff candles with a globe is not an economical method of lighting. I think I have said the worst that can be said of the electric light; and if we consider that the Jablochkoff candle gives the light of 172 candles, and that it is brought down to that by the abstraction of certainly more than 50 per cent. (I make it 58 per cent.) of the light, we have to double that at once to get the power we should through clear glass; that is 344 candles. Then we have a considerable loss also, owing to the necessity, in the case of the Jablochkoff candles, of using alternate currents, though the exact amount has scarcely been determined, I think. It is quite clear that if a large proportion of the light were emitted directly, instead of being passed through semi-opaque globes, we should multiply the light by nearly three. Then if we were to reflect those rays which are at present directed upwards and against the walls of buildings, we should be able to get another 30 or 40 per cent., which at once brings the cost very close to that of gas. In a transparent glass the light would be intolerable to the eye of a near observer. To counteract that, I think a saucer of semi-opaque glass—of opal glass, as it is called—might be placed under the light, so that when you are within, say, 50 yards, or whatever distance may be fixed, you will not see the light, and when you are at a greater distance than that, where it will not be too intense, you will see it; and if above the light there were a properly-formed reflector, you would be able, as I said before, to get from 25 to 40 per cent. of the rays which are now lost. I have considered the effect of the division of the electric current into various lights, and find the loss of illuminating power is very great—probably, so far as practice has gone up to this date, nearly as the square of the number of lights; but the exact determination of the question is beset with practical difficulties of many kinds, and I do not think that the theoretical determinations which have been made will necessarily be exactly borne out in practice. One of the occasions of the loss is the resistance of numerous carbons instead of the resistance of two carbons. The moment you begin to increase the points of resistance you must increase the difference of potential and of electromotive force, and that is an undesirable thing on many accounts. There would be a loss through the insulators, to begin with, and the machines working at high tension would, on many accounts, be more costly to maintain than machines working at low tension. For illuminating public buildings, and for many public thoroughfares, there is an indication that the cost of the electric light will come down very closely to that of gas, if not a little lower. I think, for instance, that directly the gas companies begin to concentrate their gas lights, to which there is a tendency at the present time, they will be beaten by electricity. I find by calculation that the 200-candle burners, for instance, if taken at the same rate of cost as the smaller burners, which, perhaps, is rather unfavourable to the gas, and not quite fair, would be 3¼d.; but you may allow 1¼d., and that still leaves 2d. That comes very close to the cost of even a partially subdivided electric light. The Corporation of Liverpool have a Bill before Parliament relating to electric lighting, but it has been hung up for the present, pending the decision of this Committee.

The CHAIRMAN: What legislative provisions are required to enable the Corporation to carry out electric lighting? Where are your difficulties just now?

Witness: One of the difficulties would be that we cannot break up the streets at present without special powers for doing so. The Corporation cannot break up streets, for it has been determined in other cases that we must have special powers to break up the streets for any special purposes. We can break up the streets to do certain works, to make sewers and drains, and to lay water-pipes and so on, but only to do those works. I was not aware of it until last year, but it appears that cases have been decided against a corporation, in which that corporation have broken up the streets for other purposes than those which distinctly come within their province.

If you are right in your interpretation of the existing law, that gives a practical monopoly for the lighting of all towns by all methods that require the laying of wires or anything under the streets, to the gas companies at the present moment, does it not?—I do not know whether the gas companies would have power to break up the streets for the purpose of laying wires; I should doubt it.

Would they not, for instance, if they chose to lay a gas-pipe, and put wires inside, have power to light up a town by electricity?—I am unable to answer that question.

You might do it in the same way, perhaps, by laying a sewer, and putting your wires in the sewer?—The argument would apply in either case; but then we should probably have to break up the pavement to some extent to bring the wires across.

Would the Corporation require any power for laying down the machinery?—We should require power to borrow the money; that would be all. But what I have said might possibly be misunderstood. I do not think it is absolutely essential that the wires should be laid underground. Of course, theoretically and practically, in a sense, it is an advantage to put them overhead. Electrically it is an advantage, but I am afraid that there would be difficulties when you consider the size of the wires.

At the same time, would not the wires, being placed on the tops of the houses, get over another serious difficulty—viz., that you must lay the wires about 6 feet distant from the underground telegraph wires, and that there is not always room in the street for that?—Yes; when the dynamo machine wire is running alongside of the telegraph wire, no doubt that is so, but not in merely crossing; and it is very rarely, if ever, that a telegraph wire is on both sides of a street, I think, at least in Liverpool. I was rather astonished at Mr. Preece's evidence on that point, although I have no doubt as to its correctness; but I should think that a great part of that difficulty would be overcome by the use of direct currents.

Have you formed any opinion, as an Engineer, as to who, supposing that this electric light advances much, and becomes a serious competitor with gas for public purposes, should have the power of laying the wires through the streets and distributing this light?—I am strongly of opinion that the corporation should have the power.

Perhaps, as an officer of a corporation, you will not be much inclined to admit that corporations have not shown any great energy in advancing public improvements of themselves. For instance, corporations had given them by Parliament the power of advancing tramways; but tramways would be very backward if corporations had the monopoly of that power, because they did not exercise it when they had it, and it required the stimulus of private companies to promote tramways throughout the kingdom?—That is so, no doubt; and you may say the same of wood pavements, and of many other great benefits. I think it must be admitted that it is so.

Do you not think that, if power were given to corporations, it should be given only to a limited extent, and that, if they did not use it, private companies, who had a motive for progress, should have the power which the corporations had themselves declined to use?—Yes; I do not think that legislation should be obstructive at all, as it would be if private companies were not allowed to do what corporations declined to do.

By Lord LINDSAY: With the electric lights in Paris, three independent photometrical observations gave almost exactly the same results when measured through glass globes. But with the naked light the results have come out very discordantly. Mine has come very much higher than Mons. Allard's. He only makes it 279 candles, whereas I make it 453 candles. But there is very great difficulty in measuring the light of a Jablochkoff candle by a photometer; it varies according to the position of the candle, whether you have the flat side or the edge; and the little ovoid flame is constantly moving over from one side to the other. I do not attach much importance to the measurement without the globe. With the globe the measurement is much more uniform, because reflection helps you. I may have had an exceptionally thick globe; but I am satisfied there was a loss of 58 per cent. in my case. I used Bunsen's system of photometry, but with two lights; two candles at one end of a bar placed at right angles to the line of the electric light, and at the corner I placed a gaslight of larger power—I think, of 20-candle power. I compared by a gaslight placed intermediately between the candles and the electric light. The chance of error is very much greater when you compare a small light directly with a large one. An intermediate light helps you considerably. I have not at all settled in my own mind what is necessary for the measurement of the electric light for commercial purposes; but I do not think the present system would be satisfactory. The gas which is supplied to the public in the streets has to be of a certain illuminating power, and we can guarantee a certain amount of light out of a certain burner, so that we make pretty sure of a constant light of, say, 30 candles emanating from a point. We could not be certain of that same constancy with the electric light with the apparatus at present known, but I think the light may be improved so as to overcome those difficulties; at any rate, it may be made steady, and readily regulated. I see no practical reason why that should not be done. I think there will be very great improvements in electric lamps. I think the unsteadiness of the light is not so much due to the lamps as to the inequality of the carbons; and when there is a large demand for the carbons, they will undoubtedly be manufactured of greater purity and greater homogeneity. In street lighting, we prefer many small lights rather than one large one; but there is a practical limit to that, because you have the first cost of the lamps to take into consideration as well as the maintenance and cleansing of them. We should probably have to change the carbons in the course of the night, according to any of the existing systems which have been used for public purposes, with the exception of the Wallace-Farmer lamp, and perhaps the Rapieff. I think that up to five or six lights on one circuit there is a possibility of division in series being accomplished with moderate economy; and it may be that division in multiple arc will also be carried to somewhere about the same extent. But beyond that, I think either of them will be so costly as to put a stop to further division. I am speaking entirely in the light of practical results up to this time. I know that certain mathematicians have attempted to show that it is impracticable to go further theoretically, but that is certainly not an universal opinion; there are very high authorities for the belief that there are modes of overcoming the present difficulties of subdivision. I think it quite possible that the electric light will be applied to domestic, that is to say, to chamber illumination in houses as a luxury; but, so far as I can see at present, again in the light of experience up to the present date, I do not think it is likely to be applied economically. I do not think it will damage the gas companies, even if it is applied very largely for public lighting.

Lord LINDSAY: Supposing that you had your lamps in a house in series, how would you effect the reduction of a single light without affecting the others?

Witness: Theoretically there is no difficulty in doing that as a matter of electricity; but practically, so far as I can see at the present time, I fear that the difficulty would be considerably greater than the mere turning of a stop-cock, or regulating it by a stop-cock. You would have to interpose a resistance, in fact, and, therefore, that light would cost the same, whether it was burning or not, with the exception of the carbons. That is, of course, in the case of lights in series only. But those inventors who have attempted to go further in subdivision, have placed their light in multiple arc, and then other conditions come in which render it less economical on other accounts.

You spoke about the wires being laid under the street, and you also said that it would not hurt if the dynamo wire crossed the telegraph wires. Of course it would not if it crossed it transversely; but you would very often have to lay them alongside one another, would you not?—No doubt, but not necessarily on the same side of the street.

Then that would involve cutting across your streets for every lamp-post, which would be a greater business than ever?—So it would.

By Mr. PULESTON: In my report, published in December, 1878, I say: "It may at once be stated that any attempt to reduce the electric lighting of any thoroughfare to the standard of public lighting adopted in Liverpool, or even to twice that standard, would involve an expenditure so greatly in excess of the cost of lighting by gas to the same standard as to be quite out of the question." That still remains my view. I think that, if electric lighting is used for public thoroughfares at all, it can only be with an increased standard of light. I do not think that, under any circumstances, the electric light is likely to be applicable to the present standard of illumination in public thoroughfares. We must increase the intensity of the light in the darkest places. I conclude that sentence by saying, "It is important to consider how far the cost of lighting by electricity may be reduced." What I meant was to refer to the possibility of utilizing more concentrated lights—which, *per se*, are very much more economical—by reflection in such a manner that they would give a better result than the undivided light, which, *per se*, is very uneconomical. The electric light is peculiarly well adapted for reflection, for two reasons. In the first place, the focus of the light is almost a point—in the case of gas it is not; and, in the second place, the electric light does not cause the reflectors to become smoky. One of the great difficulties in the application of reflectors to ordinary gas lights is the smokiness occasioned by the gas flame, and the consequent diminution of the reflecting power. In my conclusions in that report, I state that "the cost of the only system of public lighting by electricity at present in use is 6 times the cost of the Liverpool gas producing the same degree of illumination, and 21 times the cost of the Liverpool gas, which would, under ordinary circumstances, be consumed in the illumination of the same area;" but I have shown that, supposing the electric light, and the gas lights as well, were better placed, it would not be 6 to 1, but 4 to 1, which would at once make a considerable difference. Even to the extent to which I conceive of its being applicable, I do not think that the electric light can ever be, for domestic purposes, anything but a luxury. I do not think it will be universally used for those purposes for which gas is now used. Besides, there are many other points to be considered. The uses of gas for heating purposes, I think, are likely to be very much increased. Then, again, gas-engines are amongst the most economical engines that can be used for driving dynamo-electric machines. I saw the electric lights go out just opposite the Opéra in Paris one night, and I think

it was ten or fifteen minutes before they were re-lighted, and it certainly did leave the place very dark. It was just at the time that the Opéra was closing, and all the carriages were drawn up. That is an accident which is perhaps a little more likely to occur than the extinction of gas lights, but it does not appear to be an important consideration. It was in contemplation some time ago by the Corporation of Liverpool to purchase the gas-works, and a Committee of the Corporation sat for some time for the purpose of investigating the whole subject. About that time the Bill was promoted to give the Corporation power to use the electric light, it being thought that if the electric light was at all likely to be used, they ought to have the power to use it. That was notwithstanding my report.

Mr. PULESTON: Did that have the effect of seriously depreciating the apparent value of the gas-works for the purpose of purchase?

Witness: I do not think it had any effect on the Gas Company's shares.

Have you seen the new system of using gas in Regent Street and Queen Victoria Street?—Yes. I have already remarked that I think it is a mistake to attempt to concentrate gas. Directly the Gas Companies begin to concentrate gas, they enter into direct competition with electricity, and they will be losers, I think. One of the great advantages of gas is, that it is so easily subdivided without any loss whatever, or with scarcely any loss; there is a slight loss, but it is so trifling as to be unimportant. I think also, with respect to those lamps of 200-candle power, that they are made for the production of an effect on the pavement below. The reflectors are certainly not so arranged as to throw the light to a distance, which is what you want.

Did the Corporation of Liverpool, in promoting their Bill, contemplate the adoption of any system of electric lighting, supposing that they obtained the necessary powers?—I think they would have made experiments in the open space opposite St. George's Hall. Of course, they would have acted tentatively; and if the light had been successful there, they might have tried it in other places.

Mr. ARTHUR MOORE: Do you think, then, that the time has come when it would be wise to permit corporations to light their own streets by [illegible]

[illegible]s; I think there are many open spaces in large towns which might be illuminated by electricity with great advantage, and that corporations should have the power to light such places. I do not think it will be at present applied to streets. The Avenue de l'Opéra in Paris is quite an exceptional street, and we are not likely to have many like it in our towns.

Do you not think that if you had one or two of the wider streets lighted in this way, the shadows thrown on the side streets would be very great, and they would be at least apparently in much greater darkness than they are at present?—I am inclined to think that the electric light, if largely used, will have the effect of making the public demand a higher standard of illumination; and for that reason, if for no other, the gas companies will profit by it.

I think I understood you to say you thought the science of electric lighting was going on so rapidly, that probably, in a short time, there might be some better means of subdividing the light found?—I think there will be better means of subdividing the light; but I cannot see my way to any result approaching those proposed from America—Mr. Edison's, for example.

Has your attention been drawn to the evidence given by the Agent of the French Société, who said that there was no additional cost in dividing the light—that they could divide it simply, and make two lights instead of one, at half the cost of each?—I have seen nothing in practice to bear that out, and theoretically I do not think it is possible.

Mr. HARDCASTLE: With reference to the cost of lighting by electricity, you stated, in your report last December, that you estimated it at six times the cost of gas, but now you think that it would be four times the cost of gas?

Witness: I have not changed my mind; I have simply put it in a different light, in this way—that my estimate of December last was based on the actual placing of the electric lights which I found in the Avenue de l'Opéra; but if I had control of the Avenue de l'Opéra I should alter the position of the lights, and place them at more uniform distances; and in that case I should find a much greater relative economy from the electric light than from the gas. Both the gas, with which I compare it, and the electric light are improved, but the electric light much more than the gas, and the ratio is reduced from 6 to 1 to 4 to 1 by that process simply.

I wish to ask you distinctly, upon what basis you estimated the cost of the electric light?—I took it that the price of each candle was 7·68d. That price we know now to be reduced, and a proper allowance must be made for the fact. The intensity of the light I took at the point of least illumination in the Avenue, and calculated it, as I have stated, by taking the squares of all the distances, and dividing the illuminating power of each light by the squares.

But, taking the cost of the light at something more than 7¼d. per hour, and being informed, as we now are, that the cost is only 3d. per hour, that would reduce your present view of the cost to something less than twice the cost of the gas, would it not?—Yes, on that assumption it would, for well-placed lights in the Avenue de l'Opéra. Then I would add that if the Avenue de l'Opéra had not been so particularly favourable to the electric light—if it were any other street, a narrower street—it would come out more favourably still to gas.

But, keeping to the same standard, or test, your estimate would now be that the cost would be less than half?—If, as you say, the price has really been reduced to 3d., including interest on capital expended, and all costs whatsoever, that would be so.

But I go further than that. The price is reduced to 3d., and charging 3d., the French Company show that they have made a profit of something like 75 per cent. in nine months. Therefore, with a reasonable scale of profit, one may presume that the charge could be reduced again, at least by one-half; and thereby the light would be brought to the same price as gas?—Undoubtedly that would be so; but I must confess that I am surprised at the figures.

Sir DAVID WEDDERBURN: You stated that, by the use of opal glass globes, there was a very great loss of light; I suppose that the so-called opal glass is opaque throughout?

Witness: Yes, and I think the thickness differs very much; so that different experimenters have obtained different results.

We have had it in evidence that, by the use of transparent glass, merely frosted, the eye can be relieved from the disagreeable effect of the brilliant point of light without any considerable loss of illuminating power; have you tried that sort of glass, and can you confirm the statement?—No doubt it would be so; at least the eye would be relieved, but there would still be a very considerable loss. Even plain sheet glass—transparent glass—absorbs from 8 to 10 per cent. of the rays. I forget the figure for ordinary frosted glass; it would differ, according to circumstances, but it would absorb considerably less than opal glass. I do not, however, think that is the way to remove the difficulty; I think the rays, when you are close to the lamp, should be hidden either altogether or by opal glass, and reflected into directions in which they are more useful.

[Witness here produced a diagram, showing an arrangement he proposed to effect this object.]

With regard to the cost of the electric light, I suppose you would say that, in a general way, all the tendency of modern improvement and investigation is to reduce expense and render it cheaper?—I do not think concentrated lights will be very much reduced in cost, because I do not see where the diminution is to come from. It cannot be in the machine, because we know that very high efficiency of the machine has already been obtained. It can scarcely be to a very great extent in the lamp; but in the subdivided system I think there will be a very great increase of efficiency.

Mr. MITCHELL-HENRY: With respect to your proposal in order to shade the eye from the lamp, and reflect the light, is that theoretical, or has it been tried?

Witness: I do not know that it has been tried with the electric light. One of my points is, that justice has not been done to the electric light by reflection; but for gas purposes we know what results can be obtained by reflection. There is Skelton's catoptric lamp, which gives a very considerable increase of efficiency, but the disadvantage of using a lamp of that kind is in the maintenance. Where you only have a light of 16 candles in one lamp, the increase in the cost of each lamp becomes serious; but if you have 200 candles in one lamp, the increase of cost is comparatively small.

The CHAIRMAN: With respect to the concentrated electric lights, I think you said that the great luminosity of one light was very wasteful in illuminating streets at considerable distances?

Witness: Unless you can make use of the divergent rays, and use them in the proper direction.

Therefore, you compared it with gas, which you subdivided; but if you use concentrated gas-burners, such as those used in Waterloo Place, is there any difference between the electric light and the concentrated gas-burner?—No; then I think we get very close together, and, as I say, directly the gas companies begin to concentrate their lights they will come into very much closer competition with electricity.

I saw your surprise at the statement that the Electric Lighting Company of Paris last year made in nine months 75 per cent. We may presume that a good deal of that may have been obtained from the sale of patents, and not from the 500 lights which are burning in Paris?—I misunderstood the questioner to say that, even after the reduction to 3d., they were making 75 per cent. I should not be surprised at their making 75 per cent. with the 7·68d.; I think it is quite possible.

There are 500 electric lights burning in Paris, and there is a capital of £300,000, with one-fourth paid up. Would you not be very much surprised to find that 75 per cent. of profit had been made on such a large sum out of 500 lamps alone?—Yes, if all the capital of the Company is taken into consideration, I certainly should.

We have not seen the accounts, and therefore we may find that a considerable part of the profit is owing to the sale of patents to other countries?—That is very probable.

(*To be continued.*)

Legal Intelligence.

SUPREME COURT OF JUDICATURE—COURT OF APPEAL.

FRIDAY, MAY 9.

(*Before Lords Justices* JAMES, BRETT, *and* COTTON.)

GLOSSOP *v.* HESTON AND ISLEWORTH LOCAL BOARD.

This case, which has been several times referred to in the JOURNAL, came before the Court upon appeal from Vice-Chancellor Malins, and was argued at considerable length.

Mr. GLASSE, Q.C., and Mr. STURGES appeared for the plaintiff; Mr. HIGGINS, Q.C., and Mr. METHOLD for the defendants.

Lord Justice JAMES, in delivering judgment, said the action had been commenced under a misapprehension of the legal rights and liabilities of the Local Board, and was founded upon neglect by the Board to perform a duty cast on them by Act of Parliament, they being the Sanitary Authority of the district. If such an action could be maintained, it was a matter of supreme importance to ratepayers, because every owner of land could bring an action who could prove, or even allege, that his property would be benefited if a proper system of drainage were carried out. Upon this principle every owner of property in London could bring his action against the Metropolitan Board, if they had neglected to perfect a proper system of drainage. By the 13th section of the Act, the existing sewers of a district were vested in the sanitary authority of the district, and they were liable only as any private owner of a sewer would be, and had the same defences. The Board could be restrained from committing a legal wrong, if it were not justified by the Act; but the only duty imposed upon them was the effective drainage of the whole district; and there was no particular duty cast upon them as regarded any individual. The Board had no compulsory power of taking land, except they applied to, and had the authority of the Local Government Board; and until they had matured a scheme for the drainage of the district, they were not in a position to make such an application. The Board were only appointed in the month of November, 1875, and the action was commenced in July, 1876, at which time it could not be said that the Board had been guilty of any neglect. But were this otherwise, the plaintiff, as an individual proprietor, could not maintain his present action. If it could be shown that there had been any neglect or refusal on the part of the Board to perform the duties cast upon them by the Legislature, probably the proper remedy would be by *mandamus;* but it had not been, and it was inconsistent with the practice of the Court of Chancery to attempt to enforce indirectly, performances of such a duty by means of a mandatory injunction. The appeal must, therefore, be allowed, and the action be dismissed with costs.

Lord Justice BRETT concurred, adding that it appeared to him, from the evidence, that the drainage of the district was not in a very satisfactory condition.

Lord Justice COTTON was also of the same opinion.

The appeal was therefore allowed, with costs.

NORTHAMPTON PETTY SESSIONS.—FRIDAY, MAY 2.

(*Before Messrs.* H. MARSHALL, *Chairman*, W. HILL, J. GURNEY, *and* W. ADKINS.)

THE SUPPLY OF WATER TO CLOSETS.

Mrs. Elizabeth Parker, widow and executrix of the late Mr. Frederick Parker, summoned the Northampton Water-Works Company to recover the sum of £5, which she alleged had been overcharged by the Company in respect to water supplied to ten cottages belonging to her late husband.

Mr. ANDREW appeared for the complainant, Mr. GREEN represented the Company.

Mr. ANDREW, in opening the case, after pointing out that under the 42nd and 43rd sections of the Company's Act of Parliament the Magistrates had power to decide this case, went on to state that the late Mr. Parker owned ten cottages in No. 1 Court, Bridge Street, and the only accommoda-

tion the cottages had was three privies with pans to them. The privies had no connection with the cottages, as they were 10 or 15 yards away from them. Under the 49th section of their Act, the Company had power to charge for the supply of water for domestic purposes, to houses where there was no water-closet or bath, at the rate of not exceeding 2s. a quarter for houses under the rent of £6 10s. per annum, and at a rate of not exceeding 2s. 6d. for houses above £6 10s. and under £10 per annum; and by section 50 the Company had the power to charge 1s. 6d. extra per quarter where there was a closet or bath in a dwelling-house. What the Bench had to decide was whether the privies in question came under the provisions of that section, and were liable to this extra charge. His client had been paying at the rate of 3s. per quarter for each cottage, and he would prove that the rental of the houses was under £10 a year. Supposing there were no water-closets in the houses, the Company could only impose a rate of 2s. 6d. a quarter, but they had charged an extra 6d., and that was what his client complained of. He maintained that the privies could not certainly be said to be water-closets under the meaning of the Act, as they were only cleansed by waste water being thrown down them.

The Chairman: Do I understand that there is no pipe in the closets?

Mr. Andrew replied that there was not, and the closets were in no way connected with the water supply. Mr. Parker had written to the Company on the subject, and they had replied that the charge of 3s. per quarter commenced from December, 1873, and it was from that time up to December last that the complainant claimed to be recouped 6d. per quarter, which was alleged to be overcharged on the ten houses. The 51st section of the Company's Act said that a supply of water for domestic purposes should not include a supply of water for flushing sewers or drains, &c.; but he maintained that that section or the 50th section, which provided that a special arrangement for the supply of water other than for domestic purposes should be made, did not apply to this case; and pointed out that, although there were only three closets to the complainant's houses, the Company charged 6d. extra for each house, and that his client had to pay 5s. a quarter, whereas the Act only gave the Company power to impose a rate of 1s. 6d. on each closet, so that 6d. a quarter more was paid than the Company really had a right to charge.

Evidence on the facts of the case having been given,

Mr. Green, for the defence, after arguing that a closet that was cleansed with water was clearly a water-closet, maintained that the closets in question were water-closets within a dwelling-house, and came within the provisions of section 49. If Mr. Andrew had looked into the matter, he would have seen that the authorities were against him. In Fisher's "Digest," Vol. ii., there was a long list of cases to show that an outbuilding came within the term of dwelling-house, and he therefore asserted that closets also came within the meaning of the term. With regard to Mr. Andrew's argument that the Company only had the right to charge 1s. 6d. a quarter for each of these closets, he pointed out that section 64 of their Act empowered the Company to charge separately for each house. Mr. Andrew had admitted that the Company had the power to charge 1s. 6d. a quarter extra, but they had only charged 6d., so that they had been very considerate to the complainant. He considered that the Company's rates were most reasonable, and argued that, as the complainant did not object to the rate before payment, she could not now recover the money claimed.

After consulting in private, the Bench decided to dismiss the case.

HASTINGS BOROUGH BENCH.—Thursday, May 8.

(*Before Messrs.* H. C. Caulfeild, *Chairman*, H. N. Williams, *and* A. R. Croucher.)

CHARGE OF ASSAULTING A GAS COLLECTOR.

Captain *William Theodore Hickman*, of 9, The Mount, St. Leonards, was summoned for assaulting John Jabez Smith, a Collector in the service of the Hastings and St. Leonards Gas Company.

Mr. Davenport Jones appeared for the complainant, and Mr. Carless for the defendant.

Mr. Jones having stated the case, called

The *Complainant*, who said that Captain Hickman was a customer of the Gas Company, and on the morning of the 23rd of April he (witness) called at his house to collect the gas account. He was shown into the hall, and upon Captain Hickman presenting himself, he handed him the account. Defendant took it, saying, "What about the account?" Witness replied, "The account is correct. We have had the meter re-tested and examined, and if it had not been correct the Gas Company would have been very pleased to alter your account." Defendant replied that that was no fresh information—he had been told that before; adding that he thought he should put the matter in the hands of his solicitor. Finding that he could get no settlement, he took up his hat from the seat, remarking, as he did so, that he should acquaint the Manager with what defendant had said. He was moving towards the door, with the intention of leaving the house, when defendant, continuing to complain of the excessive amount of his gas bill, called upon him to stay till he had finished speaking. Witness apologized; but defendant, getting into a violent passion, knocked his hat out of his hand, and attempted to kick it. Witness then walked towards the door, which defendant opened, and grasping witness by the neck, put him out of the house, and in so doing caused him to fall nearly headlong down the steps. In answer to witness's remonstrances, defendant slammed the door, exclaiming that he had been insulted. Witness had not refused to leave the house.

In cross-examination by Mr. Carless, witness said that when defendant complained of the account being excessive, he (witness) did not unduly raise his voice, or speak in an insolent manner, neither did he wave his hat about while defendant was speaking. The hat was not accidentally, but deliberately knocked out of his hand. Until that time defendant had always treated him with considerable courtesy, and he was at a loss to account for his behaviour. The matter had been brought before the Director of the Gas Company.

Mr. Carless, before calling witnesses for the defence, stated that his client had always treated the collectors courteously. Captain Hickman had, unfortunately, had a dispute with the Gas Company with regard to his bill, and his (Mr. Carless's) instructions were that the complainant, when he applied for the account, behaved in a very impudent manner. Captain Hickman thereupon told him to leave the house, and moved towards the door for the purpose of opening it. In doing so he accidentally pushed complainant's hat; he indignantly repudiated kicking it. He (Mr. Carless) contended that no assault had been committed; but if Captain Hickman did eject complainant, he had a right to do so, as he was a trespasser, and refused to leave the house.

Miss *Evelyn Hickman*, daughter of defendant, stated that she heard her father say, "I'll have no more of your impertinence. Leave my house." He was guiding complainant out of the house, not pushing him out. Witness saw the Collector coming back with his hat in his hand, as if in the act of apology.

Some further corroborative evidence having been called,

The Bench, after a short deliberation, considered that the charge of assault had not been satisfactorily proved.

Mr. Jones thereupon applied for a case for the Queen's Bench, and the application was granted.

Miscellaneous News.

METROPOLIS WATER SUPPLY.

The Metropolitan Board's Costs in Connection with the Late Water Bills.

At the Meeting of the Metropolitan Board of Works on Friday last—Sir J. M. Hogg in the chair,

The Clerk (Mr. J. E. Wakefield) read the report of the Auditor appointed by the Treasury to examine into the accounts of the Board for the year ending Dec. 31, 1878. It stated, *inter alia*, that objection having been raised by certain ratepayers to charges incurred by the Board in connection with the Metropolis Water Supply Bill, 1878, and the Metropolis Water-Works (Purchase) Bill, 1878, which charges had been included in the general working account of the Board for the year ended Dec. 31, 1878, and having heard such ratepayers in support of their objection, and the Solicitor of the Board in reply, he was of opinion that the Board were not empowered by any of the legislative enactments administered by them to apply to Parliament for the powers sought by those Bills, and by virtue of the powers conferred upon him by the 195th section of the Act 18 & 19 Vict., cap. 120, he disallowed the charges, amounting in the whole to £6611 3s. 11d.

Mr. Rogers moved that the report be referred to the Works and General Purposes Committee, with power to act.

Mr. Leslie objected, on the ground that the Board were perfectly competent to deal with the matter in a proper and a public manner at once. He moved, as an amendment—"That the Board proceed to consider the statement of the Auditor."

Mr. Watkins seconded the amendment, because he said that if the Committee had power given them to act, the matter would never come to public light again. It should be remembered that the surcharge of so large a sum as nearly £7000 was a very serious question; besides which there would probably be a large further disallowance on the present year's accounts. He had no objection to sending the report to the Committee, if the words "with power to act" were struck out.

Some dissatisfaction having been expressed with both the motion and the amendment, they were withdrawn, and the Auditor's report was referred to the Committee "for consideration and report."

The Registrar-General publishes the following report on the average daily quantity of water supplied to London during April, 1879. According to the returns furnished to him by the Metropolitan Water Companies, 128,493,479 gallons, or 583,805 cubic mètres of water (equal to about as many *tuns* by measure, *tons* by weight) were supplied daily; or 230 gallons (104·5 decalitres), rather less than a *ton* by weight, to each house, and 32·3 gallons (14·7 decalitres), to each person, against 30·6 gallons during April, 1878.

Companies.	Number of Houses, &c., supplied in April, 1878.	Number of Houses, &c., supplied in April, 1879.	Aver. Daily Supply of Water in Gallons* during April, 1878.	Aver. Daily Supply of Water in Gallons* during April, 1879.
Total supply	544,381	559,464	118,335,453	128,493,479
From Thames	256,903	265,071	59,302,563	65,170,526
„ Lea and other Sources	287,478	294,393	59,032,890	63,322,953
Thames.				
Chelsea	29,014	29,700	8,182,300	7,912,300
West Middlesex	50,562	51,920	9,300,265	10,176,801
Southwark and Vauxhall	80,375	82,965	18,200,000	23,369,642
Grand Junction	38,462	39,648	10,693,898	11,054,883
Lambeth	58,490	60,838	12,926,100	12,656,900
Lea and other Sources.				
New River	126,563	128,024	26,315,000	26,831,000
East London	115,143	118,910	25,576,590	28,795,009
Kent	45,772	47,459	7,141,300	7,696,953

* Including that for manufactures and for various purposes other than for domestic consumption.

Note.—The return for April, 1879, as compared with that for the corresponding month of 1878, shows an increase of 15,083 houses, and of 10,158,026 gallons of water supplied daily.

The following is Dr. Frankland's report on his analyses of the Metropolitan Water Supply during April, 1879:—

Results of Analyses expressed in Parts per 100,000.

Companies or Local Authorities.	Total Solid Matters.	Organic Carbon.	Organic Nitrogen.	Ammonia.	Nitrogen, as Nitrates and Nitrites.	Total combined Nitrogen.	Chlorine.	Total Hardness.
Inner Circle.								
Thames—								
Chelsea	28·64	·175	·040	0	·235	·275	1·5	20·0
West Middlesex	28·20	·144	·037	0	·223	·260	1·5	20·0
Southwark	27·86	·178	·029	0	·234	·263	1·5	19·4
Grand Junction	28·80	·138	·022	0	·256	·278	1·5	20·3
Lambeth	29·66	·138	·023	0	·247	·270	1·6	21·2
Lea—								
New River	28·60	·156	·019	0	·310	·329	1·6	20·3
East London	31·12	·103	·026	0	·267	·293	1·7	21·8
Deep wells—Kent	44·46	·083	·008	0	·476	·484	2·3	37·5
Outer Circle.								
Colne Valley	13·70	·081	·013	0	·332	·345	1·4	7·0
Tottenham Local Board	40·92	·098	·025	·063	0	·077	2·9	24·3
Corporation of Birmingham*	27·80	·122	·019	·004	·154	·176	1·6	14·6
Corporation of Glasgow†	2·90	·141	·018	·001	·007	·026	0·58	1·03

* Analyzed by Dr. Alfred Hill, Medical Officer of Health and Analyst to the Borough.
† Analyzed by Dr. E. J. Mills, F.R.S., of Anderson's College, Glasgow.

Note.—The numbers in the analytical table can be converted into grains per imperial gallon by multiplying them by seven, and then moving the decimal point one place to the left. The same operation transforms the hardness in the table into degrees of hardness on Clark's scale.

"Taking the average amount of organic impurity contained in a given volume of the Kent Company's water during the nine years ending Dec., 1876, as unity, the proportional amount contained in an equal volume of water supplied by each of the Metropolitan Water Companies, and by the Tottenham Local Board of Health, was—Kent, 1·5; Colne Valley, 1·6; Tottenham, 2·1; East London, 2·2; Lambeth, 2·6; Grand Junction, 2·7; New River, 2·9; West Middlesex, 3·1; Southwark, 3·5; Chelsea, 3·6. The quality of the water taken from the Thames by the Chelsea, West Middlesex, Southwark, Grand Junction, and Lambeth Companies was much better than it has been for several months past. The best water supplied

from this source was delivered by the Lambeth Company, and the worst by the Chelsea Company. The West Middlesex Company's water was slightly turbid from inefficient filtration, and it contained dyed fibres. The other Thames waters were efficiently filtered. The Lea water distributed by the New River and East London Companies was efficiently filtered, but that of the first-named Company was not only inferior to the East London Company's water, but it was actually inferior to the water abstracted from the Thames by the Grand Junction and Lambeth Companies. The deep-well water delivered by the Kent and Colne Valley Companies and by the Tottenham Local Board of Health was clear and of its usual excellent quality for dietetic purposes. The only soft water fit for washing was supplied by the Colne Valley Company. Seen through a stratum 2 feet deep, the waters presented the following appearances:—Kent, Colne Valley, and Tottenham, clear and colourless; New River, clear and nearly colourless; East London, Lambeth, Grand Junction, Southwark, and Chelsea, clear and very pale yellow; West Middlesex, slightly turbid and very pale yellow."

GEORGETOWN (BRITISH GUIANA) GAS COMPANY, LIMITED.

The Ordinary Half-Yearly Meeting of this Company was held at the London Offices, 30, Gracechurch Street, on Tuesday, the 6th inst.—Thomas Hughes, Esq., Q.C., in the chair.

The Secretary (Mr. Alfred Lass) having read the notice convening the meeting, the following report of the Directors was taken as read:—

The Directors have much pleasure in submitting to the Shareholders the accounts of the Company for the half year ending Dec. 31, 1878.

These, with the annexed report of the Engineer, to which the Directors beg to call the attention of the Shareholders, show the progress of the Company.

The Directors have to state that the profit for the half year has amounted to £1556 13s. 10½d., which, with the balance brought from the last account, makes £3177 7s. 3d., and that, after paying the dividends to June 30, 1878, the interest on debentures to Dec. 31, 1878, and transferring a sum of £250 to the reserve-fund, there remains an available balance of £1554 8s. 9d., out of which the Directors recommend the declaration of a dividend for the half year ending the 31st day of December last, on the preference share capital at the rate of 8 per cent. per annum, and on the ordinary share capital at the rate of 7 per cent. per annum, both less income-tax (except upon those dividends payable to the local Shareholders), leaving a sum of about £390 to be carried forward to the next half year's account.

The Directors have much pleasure in reporting that from the 1st day of January last the price of gas, charged at 3·60 dols. per 1000 cubic feet, has been reduced to 3·50 dols. per 1000 cubic feet.

The Directors retiring by rotation are Thomas Hughes, Henry Palfrey Stephenson, and Matthew Whiting, who, being eligible, offer themselves for re-election.

The retiring Auditor is Robert King, who, being eligible, offers himself for re-election.

The dividend will be payable on and after the 31st day of May next.

Engineer's Report.

Gas-Works, Georgetown, Feb. 24, 1879.

To Thomas Hughes, Esq., Q.C., Chairman, and the Directors of the Georgetown (British Guiana) Gas Company, Limited.

Gentlemen,—I have much pleasure in presenting my report for the half year ending the 31st of December last. The usual monthly returns, which have been forwarded to you, have shown you the results of the half year's working, and I hope the same have been satisfactory. The works and apparatus are in an efficient state of repair. During the past half year, 1716 yards of new mains have been laid, together with 17 new services for private consumers; 19 houses have also been fitted with 136 lights, and 157 additional lights have been added by old consumers, making an addition of 293 lights, to which may be added 33 public lamps. The gas-fitting department has been satisfactorily employed.

In conclusion, I have to thank the Directors for the attention which they have given to our local requirements.

(Signed) Thos. B. Younger, Engineer and Manager.

Balance-Sheet, Dec. 31, 1878.

Dr.				Cr.			
Share capital—6200 £5 shares, fully paid up	£31,000	0	0	Fixed plant, mains, and services, as per last account.	£35,314	6	9½
Preference shares	2,060	0	0	Add since expended	280	16	3½
Debenture bonds	6,300	0	0		£35,595	3	1
Insurance-fund account	12	3	7	Stock in hand	3,553	2	1½
Retort renewal-fund account	51	14	2	Cash at bank and in hand	693	16	11
Bad debt fund	288	19	1½	Bills receivable	350	0	0
Reserve-fund	500	0	0	Amounts owing by sundry persons	2,410	3	9½
Bills payable	313	16	3				
Amounts owing to sundry persons	471	4	0½				
Suspense account	50	0	0				
Profit and loss account, net revenue	1,554	8	9				
	£42,602	5	11		£42,602	5	11

Revenue Account.

Coals and bitumen	£884	10	7	Gas and rental of meters	£3,491	18	10
Purifying account	35	15	10	Residual products and fittings, &c.	702	18	5½
Wages account	431	19	4				
Repair and maintenance of works and plant, &c.	226	11	3¾				
Salaries	617	18	4				
Rent, rates, and taxes	50	0	0				
Directors and Auditors fees	155	5	0				
Trade and general charges	193	13	7				
Bad debts and allowances	38	16	11				
Law charges	3	12	6				
	£2,638	3	4¾				
Balance carried to profit and loss, net revenue	1,556	13	10½				
	£4,194	17	3¼		£4,194	17	3¼

Profit and Loss Account (Net Revenue).

Dec. 1, 1878—				July 1, 1878—			
Dividend, &c., paid to Shareholders to June 30, 1878	£1,152	17	9	Balance brought from last account	£1,620	13	4½
Dec. 31, 1878—				Dec. 31, 1878—			
Interest on loans, debentures, &c., to Dec. 31, 1878	220	0	9	Revenue account—balance brought down	1,556	13	10½
Reserve-fund account	250	0	0				
Balance carried forward to the next half year's account	1,554	8	9				
	£3,177	7	3		£3,177	7	3

The Chairman: I have now to move that the report and accounts be received and adopted. They are, as the Shareholders will have seen, another record of the steady, though not very swift progress of the Company. The steps of that progress are remarkably satisfactory, and the Directors are very well contented with the state of things existing at the end of the half year. The report shows a satisfactory improvement upon all essential points. Thus the profit for the half year amounts to £1556, as against £1363 in the previous balance-sheet. Then the Shareholders will see that we are continuing that good habit which we commenced on the last occasion, of putting by a fair sum to the reserve-fund. We have carried £250 to that fund for the present half year, making the total amount of it £500. But I must say that I think we ought to look forward in the future, as our work grows and our profits increase, to placing a larger sum than we have hitherto done to the reserve-fund. Of course, Shareholders are aware that the concession, though a long one as concessions go, is not for all time; therefore, if, as prudent men, we wish to get back our original capital—if not for ourselves, at any rate for those who succeed us—it will certainly be necessary for us in the future, and I trust in the near future, to take stronger measures than we have hitherto seen our way to adopt as to the reserve-fund. A beginning has been made, and I trust that the Shareholders will support the Board in that direction. You will notice that we have at last seen our way to making a reduction in the price of gas—that reduction taking effect from the 1st of January—to 3½ dols. per 1000 cubic feet. That, of course, is an experiment, but we have reason to believe that it will be a successful one. I am not sure whether that reduction has anything to do with the fact—a very satisfactory one to my mind—recorded in the Engineer's report; for you will see that while, as regards the ordinary work in gas-fittings and new lights, we have not exceeded what had been done in the previous half year, yet during the past half year 33 new public lamps have been put up, and an addition of 1716 yards of new mains made to the Company's former total. As I said, I do not know whether the reduction in price has had anything to do with that increase; at any rate, there it is. It must be satisfactory to us all that we are getting a considerable increase of new mains and public lamps. Private ones, I have no doubt, will follow in due time, and thus a very considerable extension of the business of the Company will result. Altogether, we can show a distinctly better result than on the last occasion. Under all circumstances, therefore, I think we may fairly congratulate you upon the state of your business, and may also look forward to at least maintaining the very respectable dividend which we have been able to reach during the past year, if we do not carry it higher. I am happy to say that we have a gentleman present, an original Shareholder and Director of the Company, who has just returned from Demerara—I mean Mr. Quentin Hogg—and I dare say he will tell us what he thinks of the condition of the works, and also of the prospects of the colony, and whether he considers that my idea is correct that this increase of the mains and public lights shows that there is in the town a healthy tendency to grow. I sincerely hope it does. If so, of course it means a better future for us.

Mr. A. Williams seconded the motion, and it was agreed to.

Mr. Quentin Hogg said he had recently been over the works of the Company, and he certainly thought they were in a better state than they were when he saw them 18 months ago. The principal change that he noticed was that a large gasholder (the second one put up), which before was sinking in the foundations, had been put straight, and was in working order. There had been a judicious outlay in erecting a river wall in front of the Company's wharf, which considerably facilitated the discharge of coal and the delivery of coke. The Manager also told him that he was selling ammoniacal liquor occasionally for manure; and the entire stock of coke on hand he thought was practically sold to one of the planters, who was using it instead of coal. With regard to the growth of Georgetown, and the position of the colony, that depended very much on the action taken by the Select Committee with regard to sugar bounties. Continental nations were trying to swamp the West India Colonies by the bounty system, and if that iniquitous system went on, he did not see how any British sugar-growing colony could maintain its existence. No continental beet sugar could bring a fair competition against Demerara. Since he had known Georgetown, its population had increased from 30,000 to 45,000, and the tendency of the colony was to extend. As to the consumption of gas, the planters were endeavouring to curtail their expenses, and it was not to be wondered at that they should be using, as he had seen them, paraffin oil and cheap lamps, owing to the hardness of the times. He believed, however, that there was a good prospect for the colony, and he had shown his faith in it by sinking large sums of money there.

On the motion of the Chairman, a dividend of 8 per cent. on the preference shares, and 7 per cent. on the ordinary shares, was then declared.

On the motion of Mr. Arthur Clarke, seconded by Mr. Williams, Mr. Thos. Hughes, Mr. H. P. Stephenson, and Mr. Matthew Whiting were re-elected Directors of the Company; Mr. Robert King was also re-appointed Auditor.

A vote of thanks to the Chairman terminated the proceedings.

SOUTHERN DISTRICT ASSOCIATION OF GAS ENGINEERS AND MANAGERS.

The Quarterly Meeting of this Association was held on Thursday, the 8th inst., at the Maidstone Gas-Works, where the Members had been invited by the President, Mr. John West.

The following were elected Members of the Association:—

Mr. W. E. Price, jun.	Hampton Court.
Mr. G. E. Stevenson	Peterborough.
Mr. F. Livesey	South Metropolitan Gas-Works.
Mr. — Winter	Sevenoaks.
Mr. A. Thomas	Basingstoke.
Mr. G. Lane	Aylesbury.
Mr. G. B. Vanheson	Rochester.

The meeting was held in the Board Room, a paper being read by Mr. J. Hammond, of Lewes, "On a Few Facts about Ammoniacal Liquor as a Purifying Agent." The paper contained the results of working under the Author's patent system at the Lewes Gas-Works, by which it was shown that great benefit, both in the purity of the gas and also in economy, was derived from the use of caustic ammonia. A lengthy discussion followed, and a vote of thanks was passed to Mr. Hammond for his paper, and he was asked at some future time to give a continuation of the same, with diagrams showing the position in which the apparatus he advocated should be used.

After the meeting, the members, with the Chairman of the Gas Company (Mr. Ambrose Warde) and Alderman Edmett, inspected the gas-works, and were much interested in seeing the working of Mr. West's system of drawing and charging the retorts by machinery, the general opinion of the members being that the saving of labour and the many advantages derived by the adoption of the system must bring it into general use. Other specialities on the works were inspected, the Engineer explaining the advantages obtained in practice by their adoption. The new engine and exhauster house, which has only been completed a few weeks, appeared to give general satisfaction.

About 30 members afterwards dined together at the Royal Star Hotel—Mr. John West in the chair. After the usual loyal toasts, Mr. G. Livesey, of London, proposed the health of the Chairman of the Gas Company and Alderman Edmett. He expressed himself pleased with the improvements he had seen. He believed that the drawing and charging machinery used in the works was the most suitable apparatus invented to meet the general requirements of both medium and large-sized works. Mr. Warde and Alderman Edmett having replied, the President's health was proposed by Mr. C. Gandon, of Sydenham, who spoke very highly of Mr. West's ability, and stated that the members were pleased to find his health restored, and that he was able to resume his duties. Mr. West acknowledged the compliment, and the proceedings shortly afterwards terminated.

WEST OF SCOTLAND GAS MANAGERS ASSOCIATION.

(*Continued from page 727.*)

Mr. ANDREW SCOTT (Falkirk) read the following paper:—

REMARKS ON THE ANALYSIS OF GAS COALS.

My attention having being drawn to the great difference which exists between the published analyses of gas-producing coals and shales, circulated by coal proprietors and others, and the results actually obtained by the ordinary process of gas-making, I have ventured to bring this subject before you to-day, in the hope that its introduction may lead to a discussion which may go to assist in securing to gas managers a sounder and more reliable basis to calculate from, than that which they have at present.

On a coal analysis being presented to a gas manager, he first takes note of the following points:—The yield of gas per ton; the illuminating power; the quantity of ash; and the sulphur it contains. The two last are of very great importance, but as I wish to draw your attention to the yield and illuminating power only, I refrain from saying anything about them.

In the spring and summer of last year, while acting as assistant to my father at Galashiels, I tested a variety of coals in quantities of from two to three tons, and the results realized show, I think, how little reliance can be placed on the majority of analyses.

The undernoted experiments, which are selected from my list, were made with good sound retorts, and fair practical working heats. They include three first-class cannels, three third-class, and three shales.

The first figures quoted about each coal represent the published analyses, the second the results I obtained:—

Wee Lesmahagow Auchenheath.

	Cubic Feet.	Candles.	
Published analysis . .	13,163 ...	32·35 . .	*Hislop.*
Results obtained. . .	11,550 ...	32·19	
Deficiency . . .	1,613 ...	00·16	

Newbattle.

	Cubic Feet.	Candles.	
Published analysis . .	12,573 ...	33·80 . .	*Macadam.*
Results obtained. . .	11,500 ...	32·00	
Deficiency . . .	1,073 ...	1·80	

Arniston.

	Cubic Feet.	Candles.	
Published analysis . .	12,620 ...	35·25 . .	*Macadam.*
Results obtained. . .	11,460 ...	31·90	
Deficiency . . .	1,160 ...	3·35	

Bank.

	Cubic Feet.	Candles.	
Published analysis . .	10,806 ...	27·28 . .	*Moffat.*
Results obtained. . .	10,020 ...	24·30	
Deficiency . . .	786 ...	2·98	

Hartley.

	Cubic Feet.	Candles.	
Published analysis . .	9,820 ...	24·16 . .	*Wallace.*
Results obtained. . .	9,350 ...	22·00	
Deficiency . . .	470 ...	2·16	

Ferniegare.

	Cubic Feet.	Candles.	
Published analysis . .	10,640 ...	23·21 . .	*Hislop.*
Results obtained. . .	10,040 ...	22·20	
Deficiency . . .	600 ...	1·01	

Pirnie.

	Cubic Feet.	Candles.	
Published analysis . .	10,827 ...	32·47 . .	*Macadam.*
Results obtained. . .	10,800 ...	29·11	
Deficiency . . .	27 ...	3·36	

Faskine.

	Cubic Feet.	Candles.	
Published analysis . .	10,360 ...	36·37 . .	*Wallace.*
Results obtained. . .	8,300 ...	31·50	
Deficiency . . .	2,060 ...	4·87	

Westwood.

	Cubic Feet.	Candles.	
Published analysis . .	10,356 ...	39·75 . .	*Dunlop.*
Results obtained. . .	9,530 ...	34·00	
Deficiency . . .	826 ...	5·75	

The differences between these tests give ample proof that the real commercial value of gas coal is not determined on a proper principle, as, under ordinary circumstances, it is impossible to get returns within from 10 to 20 per cent. of those which are seemingly obtained by laboratory experiments. This state of matters is very unsatisfactory, and often leads to unpleasant circumstances.

Many managers in small and even moderately-sized works have no means of ascertaining the value of coal for themselves, but have to trust entirely to analyses of this exaggerated description. Such men are placed in a very awkward position at the end of their financial year, when they meet their Directors and are not able to show a return at their station-meter of, in some cases, probably 2000 feet of what they should have. The victims of analyses are immediately taken to task, for Directors, in most instances, being non-practical men, place implicit confidence in these elaborate reports, made up by men of high scientific standing.

In a couple of years, if managers took the right steps, a complete revolution could be effected in the system of coal analyses. When a coal is offered, and its analysis presented, the manager should just say he does not put much faith in these things, but that if the seller will guarantee that such results will be obtained, and be agreeable to make a deduction for any shortcomings either in regard to yield or quality, he will be quite willing to do business with him. If this recommendation were carried out, I am confident that, within the time I have mentioned, we should be receiving analyses obtained by testing large quantities of the coal in a thoroughly practical way. This would set the question of yield and illuminating power at rest, and be an incalculable benefit both to buyer and seller.

The PRESIDENT: I must congratulate Mr. Scott on his sensible remarks, which are much to the point. As there are always two sides to a story, I shall be glad to hear what any other gentleman has to say.

Mr. MITCHELL: I think this is a point on which Mr. Scott has touched rather severely. I do not think any gas manager here will take an analysis from a coalmaster, and get the same results. No reasonable man would ever expect it. Fifteen per cent. is the deduction which is recognized from the laboratory analysis, and I never yet bought a coal from its analysis without making that deduction.

Mr. HALL (Berwick): We must give the coal merchant a little fair play. One man takes one test, and another adopts a different test, and the difference often observed between the analysis and the actual make may be due to the manager, and not to the coalmaster. There is, however, only one coal that I have tested that comes up to the analysis, and that is Grange's cannel. In this case the analysis is not even enough. Thus I think that analyses ought to be more frequently made. We all know that the character of a seam of coal changes, and, therefore, I think it is desirable that there should be a more frequent analysis. The paper which has been read is very important, but I think the blame must be put upon ourselves, and not upon the results obtained. There is one thing, the importance of which has often impressed me, and that is, if we could have a testing-station, a great benefit would be conferred on gas managers.

Mr. HISLOP (Paisley): I may be allowed to make a few remarks on this subject. Altogether, one is very much surprised at the paper. First of all, the difference which Mr. Scott finds in practical working from that presented under analysis is not far to seek. The physical condition of the coal itself is sufficient to make the difference of 15 or 20 per cent. And then, in regard to the manufacture of gas, it would be most unfair to make the coalmaster responsible for the proper performance of a duty devolving upon the gas manager with respect to heats, and the quantity of gas eliminated from the ton of coal. I hold that, as a rule, the difference between practical working and a gas analysis should range somewhere under 10 per cent. It ought not to exceed that figure, if the necessary heats are retained, and the retorts kept tight. I quite agree with Mr. Hall's remarks as to analyses. It is a well-known fact that when a coal-field is being wrought, a dyke or fault comes in the way, and that alters the character of the coal. I think Mr. Hall is not far wrong in suggesting that analysis should be made more frequently, because the difference that is often found is due to the difference of position of the seam. Altogether, I really think that our friend has not brought out or proved the statement he has made, as I hold the difference is entirely due to the heats, the condition of the apparatus, and whether or not an exhauster is used; and I am bound to say that the greatest deficiency in the amount of light will be found to be very much under the control of the manager himself, and not due to the coal. Another remark has been made as to the examination of coals. A number of different coals pass through my hands, and I never make an analysis without seeing the top and bottom of the seam, and this I do in order to secure a proper representation of the coal. I have the utmost confidence that the coals passing through my hands are analyzed with the greatest care, and with the object of purchasing.

Mr. WATSON (Stirling): I think the varying pressure of gas at the holder may have something to do with the discrepancy. But again, I suppose that coalmasters, in sending samples for testing purposes, will not send the worst pieces they can find.

Mr. M'GILCHRIST: I have listened with very considerable interest to Mr. Scott's first production at our meetings, and to the discussion which has ensued. I may say that were it the case that gas managers generally find that the gas obtained from the coal comes within 10 per cent. of the laboratory test, Mr. Scott would not have read this paper on the subject. It is the experience of all of us, or at least of all to whom I have spoken on the subject, that 25 per cent. would, in many cases, be nearer the mark than 10 per cent. There is no doubt that, at the present time, there is something radically wrong with our system of testing. I do not say that it is the analyst's fault, or that it is the coalmaster's fault, or the gas manager's fault; but there it is, that analyses of coal are sent throughout the country that bear no resemblance at all to the coal you purchase. How that is the case, I know not. It may be, as one speaker has suggested, that the coalmaster selects the best coals, and it may also be that he adds to them some light hydrocarbons. However, the fact is that many gas managers are greatly annoyed by their directors expecting to get the same results from actual working as have been obtained in the laboratory. If it were possible for the system suggested by Mr. Scott to be adopted—that is, for gas managers to demand of the coalmaster that he abide by the analysis, and pay for the shortcomings, always provided that the gas manager uses the best means to extract the gas—it would be a certain cure for the evil; but I am afraid it will be a very long time indeed before we shall be able to get coalmasters to sell their goods on such favourable terms. I think the subject is a very appropriate one to bring before the Association, and I move a hearty vote of thanks to Mr. Scott for his interesting paper.

Mr. JEFFREY (Kirkintilloch): I may say, not only do some coalmasters send their worst coal, but I have seen in a ton of coal as many as two or three hundredweight of dross. Now, what sort of gas can one get out of that kind of rubbish? I think it is in this as much as anything else that the explanation of the diversity is to be found.

Mr. P. WILSON (Stonehouse): Mr. Hislop takes the top and bottom of the coal; but I do not suppose he will go down the pit to see whether there are dykes where the coal is half burned. The best pieces of coal are, doubtless, sent to him for analysis; but if he were to examine the workings he would at once see the difference in the coal.

Mr. NIVEN: I have looked into a book which I have with me, and I see that I have written down there, that from the analyses of ten different coals, a deduction, on an average, of 8 per cent. from the volume came pretty near the practical working. In inquiring into the conditions under which results are obtained, I have no doubt light will be thrown on the subject under discussion; but I was going to remark, with Mr. Mitchell, that few, if any, gas managers hold to the analysis. Of course, the analysis will be found useful for general guidance. Take any analysis you like, and take it as the basis of your calculations, and after making the deduction to which I have referred, you will find that you are very nearly correct. In practical working there is a great deal of dross, wet coals, and other drawbacks, which must be taken into consideration, and which are not considered when the analyses are made. I think the lesson which the discussion teaches us is, that we should take these analyses for our guidance, and on them we can easily base our calculations.

Mr. ADAMSON (Airdrie): I remember that the results which I obtained when inquiring into the gas-producing qualities of coal, were very similar to those obtained by Mr. Scott. I have never yet found, in practical working, that gas coal came up to the analysis supplied, and I think every gas manager here will bear me out in that remark. At the same time, I think these analyses are the basis on which gas coal may be fairly put. I think the discrepancy between the actual result in the ordinary manufacture and the results obtained at the laboratory may be accounted for, in the majority of cases, by the temperature and pressure. During last winter, for instance, when it was so cold, gas was being sold by gas managers in decreased volume compared with what is the case in the ordinary average of years. Gas managers cannot alter the outer atmosphere, as the analyst can do in his laboratory. I hold that no proper analysis of coal for a practical gas manager can be made unless five or ten tons of fair average coal are taken from the colliery. The present mode of conducting such analysis

may, in a great measure, account for the discrepancy between the analysis and the actual results obtained in ordinary practice. I have listened with great pleasure to Mr. Scott's paper, and I trust his remarks will be of benefit to the members.

Mr. DALZIELL (Kilmarnock): I think analyses are conscientiously and fairly given. Perhaps the analyst does all in his power in the interests of the coalmaster. Whenever I have an analysis put into my hand, the first thing I do is to deduct 10, 15, or even 25 per cent., and I find that, in doing so, I come pretty near to the value of the coal. I account for the discrepancy in this way:—When the analyst gets coals for analysis, they are thoroughly dried, and in good condition to be put into the retort. The gas maker gets the coal and stores it in a shed. Here there is always more or less moisture, and when the coal is put into the retort it is not in the same good condition for getting high results as when the analyst has it. Then again, in the retort-house, there is not the same care and attention bestowed by the men in charge as when the manager himself is standing behind their backs. All these things combined may go to explain why one gets so much less gas out of the coal than the analyst does. While I think that these analyses are carefully given, I would not take any of them without first deducting from 10 to 20 per cent.

Mr. MARTIN (Kilmalcolm): Perhaps these analyses are fair to the coalmaster, but they are not fair to the manager. I am engaged in a small work, where I take all the advantage I can out of the coal; and, do what I may, there is generally a difference of about 20 per cent. between the analysis and the actual result. If you take more gas from the coal, you have not the illuminating power. Therefore I think in preparing these analyses it would be better to allow a little to the manager as well as to the coalmaster, because directors are very apt to say that you do not get the same results out of the coal by 20 or 30 per cent. that a gentleman of position can take out of them.

The PRESIDENT: This has been an interesting discussion on this subject. We all know that it is a sore point, this difference between the supplied analysis and the results obtained in actual working, and I think we are pretty much of the same opinion, that we cannot get the same quantity of gas from the coal as is on the paper. We usually allow 10 or 15 per cent., and we cannot depend on getting, and we do not expect to get, nearer results. There are so many contingent circumstances—in the time lost in charging, in the smallness of the coal and dross, and in the condition of the coals themselves. The coals are not always clean, and the apparatus for carbonization and purification may not always be in the best condition to do their work, and the same results are not obtained under varying pressures. These contingencies all come in, which prevent the ordinary practical working being equal to the experiments. What would be the use of practical men unless they knew these things? In Scotland it is different from England. In the latter country they have only a few sorts of coal, while in the former we have a hundred, and the buying of coals becomes a matter for serious consideration. It would be very unsafe to depend on the analysis of coal as quoted, and I think the best way is to get a truck of coal, try it in the works, and then you can see what it is worth. I do not do that myself. I simply take the printed analysis, and I form an idea of the value of the coal. I know the respectability of the party testing, and I am able to form an opinion as to how far the analysis is correct; but before making an estimate as to how the coal will turn out, I like to see it in bulk. I think we have to congratulate ourselves upon having had this interesting discussion, and if we can hit upon some system by which these analyses would properly represent the value of coals, it would be a great advantage to gas managers.

Mr. SCOTT: I should, in reply, like to say a word or two in regard to Mr. Mitchell. He deducted something like 15 per cent. from the analysis supplied; but I do not see that that deduction can be of any use when you get amongst the coal such differences as I have referred to.

The PRESIDENT: But all the different coals require different times. Some you may get off in three hours, but you will not get off shale under four hours. The old system used to be to work shale coals for eight hours. I do not think you can work shale coal, as a rule, under four-hour charges.

Mr. SCOTT: The results I obtained were arrived at by working both coals under the best possible circumstances; and, so far as I could see, nothing remained in the ash or bulk. It was said, in the course of debate, that it was the general opinion of managers that 20 per cent. ought to be deducted from the volume specified by the analysis. Mr. Hislop said about 10 per cent. There are few managers who could show their make at their station-meter to be within 10 per cent. If coals are to be used in the laboratory, I have no objection to their being analyzed in pounds; but seeing that they are to be used in tons in a gas-works, I think some other rule ought to be adopted for the guidance of gas managers.

The PRESIDENT: I think it would be an advantage, if, in addition to the laboratory analysis, we were to have a good analysis from actual practical work; but it is not always convenient to do so.

Mr. MITCHELL: Any person who reads a properly compiled chemical analysis must have observed that the coal is mineralogically characterized, and the volatile matter contained in it described, and the whole thing brought down to the hundredth part of a grain. Now, is it possible for any sensible person to take coal, and expect to get the hundredth part of a grain at the mouth of an ordinary retort? If the report bore on its face that the analysis was the result of practical working, then certainly managers would be entitled to expect the full volume; but where is it represented as a chemical analysis, I do not see that that can be expected.

A vote of thanks was then accorded to Mr. Scott for his paper.

THE LIME QUESTION.

In order to suit the convenience of Mr. Niven, it was agreed at this stage to hear him on a question which he desired to put to the meeting.

Mr. NIVEN said: The remarks which I have to make are in reference to an important matter—namely, that of lime. In Dunoon I am very much troubled about the disposal of my waste lime, as the farmers in my district will not take it from me. Now, an important process has been going on for some time at Paisley, which is said to result in a great saving. So far as I can understand from the history of gas purification, lime will always be a most important factor in the manufacture of gas. In works like mine, the proprietors think that the manager ought to know everything, whether it be with respect to the electric light or the introduction of any new process. As a Member of this Association, I have had a great deal of light thrown on many subjects, and I thought if a committee were appointed to investigate this process of the revivification of lime, a report from them would be of great value.

The PRESIDENT: I do not see there is any necessity for the appointment of a committee. I think there is no doubt about the success of the revivifying process. I have tried it myself, and I am satisfied as to its success. If, however, the first cost is taken into consideration by those who are getting a good price for their spent lime, it is not so much a matter of importance to them; but to those who have to pay a high price for their lime and who get little for it after use, the process is of great importance. I do not see the object of appointing such a committee, but I shall be glad to hear what others have to say on the matter.

Mr. JEFFREY: I have much pleasure in seconding Mr. Niven's motion. This process is not much known, and the sooner it is made public the better. I think a committee should be appointed to inquire into the subject, and report to next meeting.

Mr. HISLOP: When I came here I had not the slightest idea that this matter would be referred to. I may say that at the present moment I have a circular in proof, a copy of which you will all possess very shortly, on the subject. I may say that the process has been in operation for a considerable time, but from pressure of other business I have not had time to get up the circular to which I have referred. The process is going on very satisfactorily indeed. I am continually making experiments, and I have been endeavouring, up to this time, to improve the process, if possible. I think it is now very near perfection, the result of working with shorter chambers than I intended to produce. I get my spent lime restored at a sum not exceeding 8s. 6d. per ton. I am prepared to produce it on any scale. I have been producing it for a year and a half at all events. I shall be glad to see any person who desires to investigate the process, either from this Association or otherwise. There are a great many inquiries about it, and I hope to meet these by showing it to gentlemen.

Mr. M'GILCHRIST: I think the best thing that an Association like this can do is to investigate any process that may be brought out, and I think the revivification of lime is one of those subjects which ought to be investigated by a committee; for this reason, that managers of moderate or small works cannot be at the expense of getting the apparatus fitted up at their works without knowing its value. Probably, too, that which might be suitable for large works would be unsuitable for small ones; so I think Mr. Niven's is a good suggestion, and I shall support it. If Mr. Niven would make a suggestion as to whom the committee should consist of, perhaps it would assist us in coming to a settlement on this point.

Mr. NIVEN: The President, Vice-President, and the members of the Committee of the Association.

Mr. MITCHELL: As far as circumstances will permit, I shall take pleasure in investigating the process.

Mr. DALZIEL: I see from the JOURNAL OF GAS LIGHTING that some inquiry has been made regarding Mr. Hislop's process, or something like it; but I think we ought to investigate for ourselves.

It was then agreed to leave the matter in the hands of the Committee of the Association.

(To be continued.)

THE LANCASHIRE COAL AND IRON TRADES.

(FROM OUR OWN CORRESPONDENT.)

The Lancashire coal trade is very dull, the only relief to the general depression being a little extra demand for the better classes of round coal, owing to the coldness of the weather, and the continuance of the Durham strike. This has kept a few of the best coal collieries fairly employed, but for all other classes of fuel the inquiry is very small, and supplies are very much in excess of the requirements of consumers, notwithstanding that a good deal of short time is now being worked at the pits. For gas coals there is some inquiry, and a few important contracts are being concluded; but these are very keenly competed for, and the prices at which tenders are now being sent in fully confirm the anticipations which I have held out in previous reports. The Manchester Corporation, I understand, have received some extraordinarily low tenders, not only from local firms, but from colliery proprietors in outside districts, where the coal is weighted with a heavy delivery rate; and at one large town not far from Manchester, I am informed that a contract for Lancashire cannel of a fair quality has been concluded at 13s. per ton delivered at the works. A good many buyers seem to be holding back from covering all their requirements at present, and, in some cases, contracts are being asked for with deliveries to commence in June next year; but, although such terms as these do not meet with much response, there are not a few sellers who would be willing to contract over two years, with deliveries to commence at once. To sum up the gas coal trade, I may state that the market is generally in favour of buyers, who, in most cases, will be able to secure contracts at lower prices than were being paid last year, and in some cases there is little doubt that very considerable concessions on last season's prices will be obtainable. It is difficult to quote any fixed price at which colliery proprietors are willing to sell, but good ordinary screened Lancashire gas coal, similar in quality to the Wigan four-feet or inferior Arley, could be bought at from 6s. to 7s. per ton, and in some cases at rather less. In other classes of fuel there is not much to report that is new. Steam and forge coals, burgy, and slack are still abundant in the market, and where colliery proprietors have stocks on hand, extremely low prices are being taken.

In the iron trade there is a great deal of cutting in prices to secure orders, and local makers of pig iron have to quote extremely low figures to obtain business, owing to the keen competition of outside brands. In the manufactured iron trade makers are also willing to quote lower figures to secure good specifications. Lancashire pig iron, delivered into the Manchester district, may be quoted at about 45s. per ton, less 2½ per cent., for No. 2 foundry, and 44s. for No. 4 forge; and Lancashire bars at about £5 10s. to £5 15s. per ton.

THE COAL AND GENERAL TRADE OF THE NORTH OF ENGLAND.

(FROM OUR OWN CORRESPONDENT.)

The strike of the Durham miners, which had lasted ten weeks, was eventually brought to a close on Thursday evening, by the award of Mr. J. Bradshaw, the Northumberland County Court Judge, who had been chosen umpire by the joint committee of the owners and miners. The strike ended exactly as we indicated—and it might as well have been over a fortnight ago—by "splitting the difference." The masters asked a reduction of 10 per cent. on wages at once; and to arbitrate on the other 10 per cent. in dispute. The men were willing to concede 7½ per cent. reduction, and arbitrate on the remainder. Mr. Bradshaw awarded an immediate reduction of 8¾ per cent. The men at some of the collieries attempted to resist the award; the difficulty, however, has been got over. Several pits were at work on Friday and Saturday. They would be all in about full employment yesterday (Monday). The steamers carrying gas coals to London, Havre, Rouen, and Hamburg have been got into the Tyne Dock and are loading. The fleet of boats belonging to the collieries, and which trade regularly with the leading gas-works of the places mentioned above, will all be loaded and off from the Tyne Dock, it is anticipated, by Wednesday.

There is an active inquiry for steamers to load gas coals for Cronstadt. The last quotation is about 7s. per ton. Steamers have also been in active request to load gas coals for the Italian ports of the Mediterranean at advanced rates. Steamers have likewise been taken up to load gas coals for Odessa and some of the other ports of the Black Sea. There is not so very urgent demand for small sailing vessels to load gas coals for the bye-ports on the English coast as was anticipated. The freight for steamers to load coals for London is a little over 4s. Sailing ships to discharge gas coals at the wharves below bridge in London river at 5s. per ton.

The Northumberland collieries are very busy. Turns are long.

A serious crisis has arisen in the Cleveland iron district, through the stoppage of three large firms, two of them limited liability companies,

with heavy obligations. It is feared that the mischief is not all over yet, and the greatest anxiety prevails.

The demand for fire-clay goods and fire-bricks from the Tyne is well sustained. A quantity of water and gas pipes are being manufactured at one or two large iron-works in the North. Sewerage-pipes are also in much demand for the Continent. The chemical business is very much depressed, with little prospect of improvement.

(By Telegraph.)

Newcastle-on-Tyne, *Monday Night.*

Messrs. Joicey's and several other large gas collieries are at work to-day. Pelaw, Washington, Usworth, Hebburn, and some other North Durham pits, are still off, the men refusing to comply with the Umpire's decision. All will be at work by Wednesday. There is plenty of shipping, for the trade freights are not higher.

TRADE NOTES FROM SCOTLAND.

(from our own correspondent.)

The annual general meeting of the Strathaven Gas Company was held last Tuesday evening—Mr. T. Tennent, banker, presiding. The report for the past year submitted by the Directors showed that the works were in excellent condition, yielded a fair return in the shape of profit, and allowed a respectable balance to be set apart to meet contingencies.

At the annual meeting of the Gas Company of Methven, Perthshire, which was held some days ago, a dividend of 5 per cent. was declared. All the office-bearers were re-elected.

On Monday, the 12th inst., the Magistrates and Councillors of Arbroath, acting under the local Gas Corporation Act, held a meeting—Bailie Reid in the chair. Mr. A. M. Thomson, accountant, was re-appointed Auditor of the Gas Corporation accounts for the next year. One of the Commissioners gave notice that at the next meeting he would move—"That, as the work at the gas-works was severe and exhausting, the working hours be reduced from 84 to 56 hours per week." The Works Committee, reporting upon the question of Sunday labour, said that while regretting the necessity of employing the men on Sunday, they could not see their way to order any radical change in the present system; but they suggested that the Manager be instructed to give relief to men engaged on Sundays, as often as they desired it.

At a meeting of the Dundee Police Commissioners held on the 12th inst., it was reported that the Lighting Committee were engaged in the careful consideration of the whole subject of street lighting, more particularly as to the construction of the street-lamps, the increase of illuminating power in the lamps, and the practicability of reducing their number thereby, or by re-distribution, and also as to the partial adoption of the electric light, the remit granting full powers to make all necessary inquiries. In the meantime, the Committee have remitted to the Gas Manager to consider the whole matter, and submit suggestions to them for their consideration.

The Paisley Gas Commissioners, at their usual monthly meeting, held on Tuesday last, had again under consideration the question of dealing with the surplus gas profits. Two of the Commissioners brought forward a motion asking that the sum of £1000 instead of £500 be taken out of the surplus for street improvements, but the further consideration of the question was ultimately left over for a month or two.

At the annual general meeting of the Innerleithen Gaslight Company, which was held a few days ago—Mr. George Ballantyne in the chair—the Directors report for the past year, with statement of accounts and balance-sheet, was read by the secretary, and adopted. After making allowance for depreciation, and carrying between £200 and £300 forward to the reserve-fund, a dividend of 8 per cent. per annum was declared. The price of the gas was reduced from 6s. 3d. to 5s. 10d. per 1000 cubic feet, the lowest figure reached since the Company was established. The two retiring Directors (Messrs. George Ballantyne and James Shiell) were re-elected; and Mr. J. W. Walker was elected to fill the place of Mr. J. W. Dobson, who withdrew from office. The leakage and condensation for the past year were a little over 11 per cent., while the make for the same period amounted to nearly 6¼ million cubic feet, the gas produced per ton of coal being close on 10,250 cubic feet. The average illuminating power was equal to 29 candles.

Business was done in Edinburgh last Wednesday in the Edinburgh Gas Company's shares at £45, in Edinburgh Water Annuities at £146, and in Aberdeen Gas Annuities at £5 15s. On the following day the Glasgow Gas Corporation 9 per cent. Annuities experienced an advance of £4, closing at £210; and the 6¾ per cent. Annuities gained £1 2s. 6d., closing at £153 15s. Glasgow Water Corporation 4 per cent. Annuities changed hands on Friday at an advance of 10s., the close being £102.

Another burst of one of the Dundee and Lintrathen water-pipes was reported on Friday morning. Much damage was done to the fields under crop at Burnmouth, near Newtyle, by the immense flood of water which escaped.

On the 12th inst. there were 46,426,000 gals. of water in the reservoirs belonging to the Dumbarton Water-Works. The consumption is yearly increasing, and it is now up to 450,000 gals. per day. At this rate the stock in store on the 12th inst. was equal to a supply for 103 days.

At the last meeting of the Leith Town Council a motion was submitted by Councillor Steven—"That steps be taken to have a monthly analysis of the water being supplied to the town." After a long discussion, it was eventually agreed to instruct the Public Health Committee to take an analysis at such times as they thought fit. It may be remembered that Leith is supplied from the Edinburgh and District Water Trustees works.

A special meeting of the Town Council of Galashiels was held last Monday evening, to consider and dispose of a report by Messrs. Leslie on what should be done with the Knowes Dean reservoir, by way of stopping the leakage which has so long been a source of anxiety both to the Engineers and the Municipal Authorities. Provost Hall presided. Two alternative plans were given. One of the plans proceeded on the assumption that the puddle trench, 7 feet below the bottom of the reservoir, was water-tight, and that it was at that depth that the leakage occurred; further, that the water somehow found its way round the south end of the embankment. It was proposed to dig down to the depth mentioned, and excavate further into the south side, with the view of ascertaining the seat of the leakage. An alternative and more costly plan was to place a new puddle trench inside and close to the foot of the embankment, across the entire reservoir, and from the top of this new puddle trench to lay a bed or facing of concrete on the front of the mound. The Water Committee recommended the adoption of the first plan, which was agreed to by the Council.

With the view of providing an abundant supply of water for the town of Hawick, the Civic Authorities have just resolved to employ competent engineers to examine the various sources whence a possible supply may be obtained, and report. The opinion of Provost Watson is that provision should be made for the next 18 years at least, which would require something like 600,000 or 700,000 gallons per day additional, it being estimated that the town would, in the course of 20 years or so, increase to a population of nearly 50,000. The proposed additional supply would make the total amount about a million gallons per day.

The Glasgow pig iron warrant was dull during the past week, and on Friday the closing quotations were—Buyers, 42s. 8½d. cash, and 42s. 10½d. one month; sellers very near.

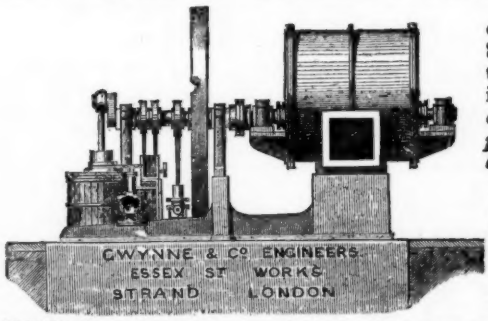
In the Glasgow coal market business has once more assumed the quieter appearance that is usual during summer. For house descriptions orders are somewhat scarcer, and shipping orders show signs of curtailment.

Reduction in the Price of Gas at Leek.—The Leek Improvement Commissioners have resolved to reduce the price of all gas consumed since Jan. 1 last—when the half-yearly consumption is under 20,000 cubic feet, to 4s. per 1000; when it amounts to 20,000 and is under 40,000 cubic feet, to 3s. 10d. per 1000; and when it amounts to 40,000 and upwards, to 3s. 8d. per 1000; the former prices being 4s. 3d., 4s., and 3s. 9d., respectively. Also to allow a discount of 6d. per 1000 feet on all accounts paid at the office on or before July 20th, and 3d. per 1000 if paid between the 20th of July and the 15th of August following.

Sales of Gas Shares.—On Friday, the 9th inst., 20 £10 shares in the Hinckley Gaslight and Coke Company, Limited, were offered for sale at the Crown Inn, Hinckley, by Messrs. J. and W. Harrold. The shares, upon which £7 10s. had been paid up, were put up in ten lots of two shares each, and realized from £24 to £24 10s. each lot, the total being £243 5s. Gas was first introduced into Hinckley in 1834, and this is the first sale of gas shares by public auction that has taken place.—At a sale of Ashford (Kent) Gas Company's shares, on Tuesday, the 6th inst., seven £10 shares sold, one for £15 5s., and the rest at £15 10s. each.—On the 30th ult., £950 stock in the Brentford Gas Company were sold, at the Mart, Tokenhouse Yard, at 65 per cent. premium.—At Benfieldside, last week, nine lots of shares in the Shotley Bridge and Consett District Gas Company were sold. Lots 1 to 7, of £100 each, bearing 10 per cent. dividend, realized £172, £174, £180, £182, £181, £180, and £185 respectively; lot 8, £80 do., £144; while lot 9, £130 of 7 per cent. stock, sold for £166 8s. To show the remarkable change of opinion as to the value of this property, it may be mentioned that the stock just sold at prices varying from £172 to £185 was offered in the market by a sharebroker six months ago at £160, and refused, on account of the electric light scare.

The GRAND MEDAL of MERIT at the VIENNA EXHIBITION, TWO MEDALS at the PHILADELPHIA EXHIBITION and TWO MEDALS at the PARIS EXHIBITION, have been AWARDED to GWYNNE & CO. for GAS-EXHAUSTERS, ENGINES, and PUMPS; Also 27 OTHER MEDALS AWARDED at all the GREAT INTERNATIONAL EXHIBITIONS.

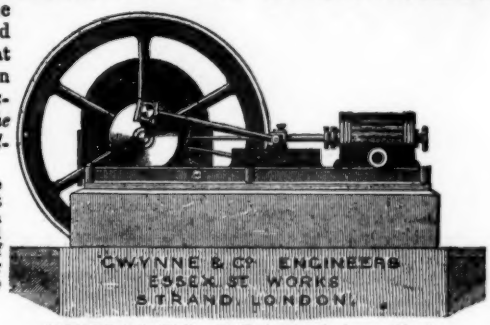
GWYNNE & BEALE'S PATENT GAS-EXHAUSTERS & ENGINES.



EXHAUSTER with Trunk Engine, capable of passing 210,000 cubic feet per hour.

The Judges report on the combined Exhauster and Steam-Engine exhibited at the Philadelphia Exhibition is—"*Reliable compact Machine, well adapted for the purpose intended, of excellent workmanship.*"

GWYNNE & CO. have made the largest and most perfect Gas-Exhausting Machinery in the world, and have completed Exhausters to the extent of 8,000,000 cubic feet passed per hour, of all sizes from 2000 to 210,000 cubic feet per hour.



52,500 EXHAUSTER, with Horizontal Engine combined.

GWYNNE & CO. do not pretend to enter into a struggle with other makers in respect to cheapness. They have never sought to make price the chief consideration, *but to produce machinery of the very highest quality, and most approved design and workmanship.* The result is that in every instance their work is giving the fullest satisfaction. Numerous testimonials and references can be given to Companies using their Machinery for years past.

Exhausters, with or without Engines combined, can be made to pass the gas WITHOUT OSCILLATION OR VARIATION IN PRESSURE Regulators, Bye-Passes, Stop-Valves, Gas-Valves, Station Governors, and Gas Machinery of all Sizes.

PLEASE ADDRESS IN FULL, GWYNNE & CO., Hydraulic and Gas Engineers, ESSEX STREET WORKS, VICTORIA EMBANKMENT, LONDON, W.C., ENGLAND.

Gwynne & Co.'s New Catalogue on Gas-Exhausting and other Machinery may be obtained on application at the above Address.

WANTED, Readers of the NEW Edition, 1879, "Cooking & Heating by Gas;" on Burners, &c. Copies, by post, Threepence, direct from the Author, MAGNUS OHREN, A.I.C.E., Gas-Works, SYDENHAM, S.E.

WANTED, a thoroughly competent RETORT SETTER. Permanent employment. References as to character and experience required.
Apply by letter to S. SOWOOD, Superintendent, Gas-Works, GRAVESEND.

WANTED, by a young married man, a Situation as MANAGER or MANAGER and SECRETARY of a Gas-Works where the make is about 15 or 20 million cubic feet per annum, or Assistant Manager to large Gas-Works; having a thorough practical knowledge of the Meter, Mains, and Fitting department. The highest references can be given.
Address 215, Post Office, CHELTENHAM.

ILKESTON LOCAL BOARD.

WANTED, a competent Man to act as PLUMBER, Glazier, and Gas-Fitter for the Ilkeston Local Board. Wages 26s. per week.
Applications and testimonials of recent date to be sent to me not later than Friday, the 30th inst.
By order,
WRIGHT LISSETT, Clerk to the Board.
Town Hall, Ilkeston, May 17, 1879.

AN experienced wood-sieve maker is open to a RE-ENGAGEMENT. In a Gas-Works preferred.
Address W. K., 12, Brill Terrace, Pancras Road, LONDON.

ADVERTISER, a Blacksmith, with 16 years experience in Meter Factory, latterly as Foreman, desires a SITUATION. Thoroughly understands Construction, Erection, and Testing of all Meters. First class references.
Address A. C., 45, Fleet Street, LONDON.

TO GAS COMPANIES.

ADVERTISER wishes a Re-engagement as MANAGER. Make from 3 to 20 millions. Over 30 years practical experience in the general routine of the business. Eleven years in last engagement; good references.
Address E. G., 93, Main Street, CARRICK-ON-SUIR.

OPEN to an Engagement early in August. A person who has had 16 years experience as a Gas Manager, and was for six years privately employed as a Gas Engineer in the Erection of Gas-Works, Laying Main and Service Pipes, &c. Would take a subordinate position in a large works. Can furnish satisfactory testimonials as to character and qualifications.
Address No. 548, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

RUGBY.

TO BE SOLD by Auction, by Messrs. Tait and Bird, at the George Hotel, Rugby, on Tuesday, May 27, 1879, at Four for Five o'clock in the afternoon, 123 GAS SHARES of £10 each (fully paid up) in the Rugby Gaslight and Coke Company, Limited, in Twelve lots of ten shares each, and One lot of three shares.
Particulars may be obtained of the AUCTIONEERS, or at the Office of Messrs. L. and J. H. BENN, Solicitors, RUGBY.

EXHAUSTER FOR SALE.

FOR SALE, an Engine and Exhauster combined, to pass 7000 feet per hour, together with Boiler, 12 ft. by 4 ft., Boiler Fittings, Connections, Regulator, and Stone Bed.
For particulars, apply to W. T. TEW, Gas-Works, WARWICK.

PURIFIERS FOR SALE.

FOR SALE, price £60.—The Plates forming a Set of Two Purifiers, 12 ft. by 4 ft. 6 in. by 4 ft. deep, together with wrought-iron Covers, Lifting Tackle, Wood Sieves, Hydraulic Valve, and Connections The above are all equal to new, and very handy, requiring little floor space.
Apply to the MANAGER, Gas-Works, STONEHAVEN, N.B.

PURIFIERS FOR SALE.

THE Ventnor Gas and Water Company have FOR SALE, Four 6-ft. Square PURIFIERS, with Centre-Valve and Connections complete.
Further information may be obtained from FLETCHER W. STEVENSON, Secretary and Manager.

A Few Tanks, 3-16ths and ¼-in. Plates, well stayed, and from 1000 gallons to 3000 gallons, all just new, are FOR SALE cheap. Also an AIR-PUMP and ENGINE, £20; a CENTRIFUGAL PUMP, 3-in. delivery, £6; also some Large Wooden Tanks.
Apply at the Colour Works, Frogmore, WANDSWORTH.

TO BE SOLD, Cheap, Three Telescopic GASHOLDERS, two 60 ft. diameter and 20 ft. deep each lift, and one 70 ft. in diameter and 20 ft. deep. Only been in use eight years. May now be seen at work at the Effingham Street Gas-Works, Sheffield.
For price, apply to THOMAS PIGGOTT AND CO., Spring Hill, BIRMINGHAM.

GASHOLDER FOR SALE.

THE Sleaford Gas Company, Limited, have for disposal a GASHOLDER, 32 ft. in diameter by 14 ft. deep, with Counterbalance Weights and Chains, Stone Columns, 5-in. Inlet and Outlet Pipes, Syphons, and Slide-Valves, all complete, the whole in splendid condition and at present in use. To be moved to make room for extensions.
Can be seen, and full particulars obtained, on application to the undersigned.
By order,
HARRY WIMHURST, Manager.
Gas-Works, Sleaford, May 7, 1879.

THE Directors of the Slough Gas and Coke Company are prepared to receive TENDERS for the construction of a GASHOLDER-TANK and a Telescopic GASHOLDER, 50 ft. diameter by 28 ft. deep. Also a RETORT-HOUSE and COAL STORES.
Drawings, specifications, and conditions of contract may be seen at the Office of the Company, 1, Chandos Street, Slough, Bucks, between the hours of Ten and Four.
Tenders to be delivered at my Office on or before Monday, the 2nd day of June next, addressed to the Chairman, and endorsed respectively, "Tender for Tank," "Tender for Gasholder," "Tender for Retort-House," and "Tender for Roofs."
The Directors do not bind themselves to accept the lowest or any tender.
ARTHUR THOMAS, Secretary.
1, Chandos Street, Slough, May 17, 1879.

GAS PLANT FOR SALE.

A 10-in. Vertical Pipe Condenser, having 20 Pipes, each 19 ft. high, on Cast-Iron Base Box.
A Scrubber, 16 ft. high 5¼ ft. diameter, fitted with thin boards, Self-Acting Liquor Distributor, 10-in. inlet and outlet pipes.
Two Single-Flue Cornish Boilers (new in 1870), each 9½ ft. long, 3 ft. 9 in. diameter; Fire Tube of Low Moor Iron, complete with all Fittings.
All in good working order; removed to make room for larger plant.
For further particulars apply to THOS. TREWHITT, Gas-Works, WEST HARTLEPOOL.
May 8, 1879.

GUILDFORD GASLIGHT AND COKE COMPANY.

THE Directors of this Company are prepared to receive TENDERS for the TAR and LIQUOR produced at their Works for the year commencing July 1, 1879.
Tenders, properly endorsed, to be sent, on or before Wednesday, June 10, 1879, to Mr. LONGWORTH, Gas Offices, GUILDFORD, from whom any further required information may be obtained.

THE Directors of the Newmarket Gas- light Company are prepared to receive TENDERS for the Supply of 2000 Tons of Best GAS COAL, to be delivered as required during the next Twelve months ending May 31, 1880.
Tenders, stating price per ton, delivered free at the Great Eastern Railway Station, Newmarket, to be sent on or before Monday, June 2, 1879, to the undersigned, from whom any further information may be obtained.
THOMAS WILKINSON, Manager.

ROSSENDALE UNION GAS COMPANY.

TENDERS are invited for the Supply of COAL, SLACK, and CANNEL for a term of One, Two, and Three years, from the 30th of June next. Quantity required per annum about 9000 tons of Coal and 5000 tons of Cannel.
Tenders to be sent in not later than June 3, 1879, and addressed to the Chairman of the Gas Company, endorsed "Tender for Coal and Cannel."
JAMES RILEY, Manager.
Slough Fold, near Manchester, May 8, 1879.

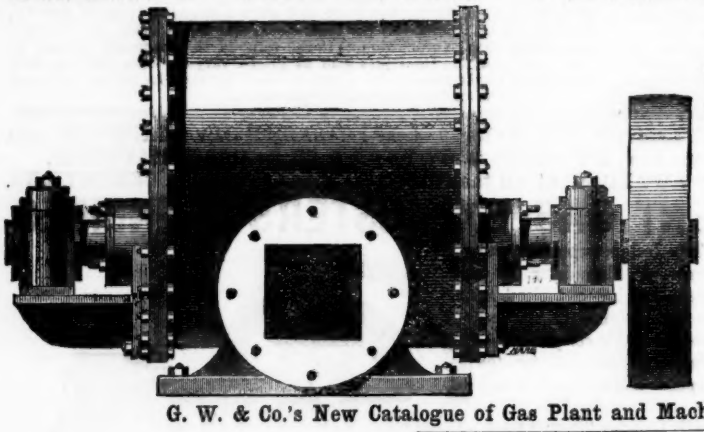
BOROUGH OF SOUTHPORT.

THE Gas Committee are prepared to receive TENDERS for the Supply of FIRE-CLAY RETORTS and FIRE-BRICKS required at the Corporation Gas-Works, Crowlands.
Further information may be obtained on application to Mr. John Booth, Gas Manager.
Tenders, properly endorsed, to be sent in to the undersigned not later than the 28th inst.
By order,
KEIGHLEY WALTON, Town Clerk.
Town Hall, Southport, May 17, 1879.

BOROUGH OF BIRMINGHAM.

THE Gas Committee of the Town Council invite TENDERS for the Purchase of the surplus TAR to be produced and manufactured at their works at Adderley Street and Windsor Street, Birmingham, and at West Bromwich, for a period of One year, from July 1, 1879.
Tenders may be made for the supply from one or more of the works.
Further information and forms of tender may be obtained on application to me,
EDWIN SMITH, Secretary.
Offices of the Department, Old Square, Birmingham.

BEALE'S IMPROVED PATENT GAS EXHAUSTERS,



WITH OR WITHOUT
WROUGHT-IRON SPINDLES AND
ENGINES COMBINED.

GEORGE WALLER & CO.,
MAKERS OF
ENGINES, EXHAUSTERS,
INDEX AND DISC GAS-VALVES,
HYDRAULIC MAIN VALVES,
BYE-PASS VALVES,
TAR, LIQUOR, AND OTHER PUMPS,
SCRUBBERS AND PURIFIERS,
CONDENSERS, BOILERS, &c.

G. W. & Co.'s New Catalogue of Gas Plant and Machinery can be had on application.

PHŒNIX ENGINEERING WORKS:
HOLLAND STREET, SOUTHWARK, S.E.

TO GAS ENGINEERS.

D. BRUCE PEEBLES & CO.

Beg to call the attention of Gas Engineers to the fact that the novel and original feature in connection with PEEBLES' SYSTEM OF CONTROLLING THE ACTION OF GAS GOVERNORS is the loading or acting on the Bell by Pneumatic Pressure instead of Weights.

TAY WORKS, BONNINGTON, EDINBURGH.

THE Directors of the Newmarket Gas-light Company invite TENDERS for the AMMONIACAL LIQUOR produced at their Works for One year ending June 30, 1880.

Tenders to be sent on or before Monday, June 2, 1879, to the undersigned, from whom any further particulars may be obtained.

THOMAS WILKINSON, Manager.

TO MANUFACTURING CHEMISTS.

THE Gas Committee of the Keighley Local Board of Health are prepared to receive TENDERS for the TAR and AMMONIACAL LIQUOR manufactured at their Works, from the 1st of July next to the 30th of June, 1880.

Particulars and form of tender can be obtained on application to the undersigned, at the Gas Office, Low Bridge, Keighley, to whom tenders must be sent not later than the 26th inst.

By order,
JOHN LAYCOCK, Engineer.

Gas Office, Low Bridge, May 9, 1879.

THE Sunbury-on-Thames Gas Company have FOR SALE the following PLANT in good condition, thrown out to give place to larger:—

Two Purifiers, 6 ft. by 3 ft. by 3 ft. 6 in. deep.
Two do., 5 ft. by 3 ft. by 3 ft. deep.
6-in. Connections, with two Lifting Screws and Travellers complete.
Six 6-in. Cathels's Patent Four-way Valves.
Station-Meter to pass 1500 ft. per hour, 4-in. Connections.
4-in. Governor.
5-in. Pipe Condenser.
Six 6-in. Donkin's Valves.

For further particulars apply to Mr. JOHN SMITH, Manager, Gas-Works, Sunbury-on-Thames, MIDDLESEX.

THE Trustees for the District and Harbour of Maryport are prepared to receive TENDERS for the Purchase of the AMMONIACAL LIQUOR made at their Gas-Works for One year, commencing on the 1st of July next; and also for the Purchase of the Surplus TAR made at the said Gas-Works for a like term. Both to be delivered into the purchaser's barrels at the Gas-Works.

The Trustees are not bound to accept the highest or any tender.

Sealed Tenders, endorsed "Tender for Tar," or "Ammoniacal Liquor," as the case may be, to be sent to the undersigned on or before the 2nd of June next.

JOHN BARWISE, Clerk to the Trustees.

Harbour Office, Maryport, May 17, 1879.

TENDERS FOR AMMONIACAL LIQUOR.

THE Gas Committee of the Dewsbury Corporation are prepared to receive TENDERS for One, Two, or Three years (as may be agreed upon) for the Purchase of the AMMONIACAL LIQUOR produced at their New Gas-Works, Savile Town, which are situated close to the Canal. Quantity of Coal carbonized about 13,000 tons per annum.

Sealed tenders, endorsed "Tender for Ammoniacal Liquor," stating the price per ton per unit per centum of Ammonium Sulphate, to be sent to Jesse Smith, Esq., Town Clerk, on or before Tuesday, the 27th inst.

Any further information may be had on application to the undersigned.

The Committee do not bind themselves to accept the highest or any tender.

CHAS. ARMITAGE, Engineer and Manager.

PADIHAM AND HAPTON LOCAL BOARD.

TO COLLIERY PROPRIETORS AND OTHERS.

THE above-named Local Board are pre- pared to receive TENDERS for the Supply of GAS COALS for Two years, commencing on the 1st day of July next, to be delivered free at the Padiham Railway Station as may be required. Estimated quantity about 4000 Tons.

Information may be obtained on application to Mr. J. R. Smith, Gas Manager, Padiham.

Sealed tenders, endorsed "Tender for Gas Coals," stating the colliery from whence the coal is proposed to be supplied, to be sent to me, the undersigned, on or before the 31st of May.

The Board do not bind themselves to accept the lowest or any tender.

By order,
ROBERT DUCKWORTH, Clerk to the Board.

Padiham, May 16, 1879.

THE Whitstable Gas Company require two new PURIFIERS, 6 ft. square by 3 ft. deep, with Centre-Valve for four Purifiers, Lifting Apparatus, Connections, &c.

For particulars apply to R. DARNEY, FAVERSHAM.

HUELVA GAS COMPANY, LIMITED.

THE Directors of this Company are pre- pared to receive TENDERS for the Construction of GAS-WORKS at Huelva, in Spain. Tenders may either be for the whole work in one contract, or for the iron-work alone.

Plans may be seen and copies of the specification may be obtained at the Office of Mr. W. R. Copland, 83, West Regent Street, Glasgow, Engineer to the Company.

Sealed tenders for the whole of the work or for the iron-work alone, endorsed "Tender for Gas-Works" or "Tender for Ironwork," as the case may be, must be lodged with the Subscriber on or before Monday, the 26th current, at Twelve noon.

The Directors will not bind themselves to accept the lowest or any offer.

WM. SIMPSON, Secretary to the Company.

21, West Nile Street, Glasgow, May 3, 1879.

BRISTOL UNITED GASLIGHT COMPANY.

TENDER FOR COALS.

THE Directors of the Bristol United Gas- light Company invite TENDERS for the Supply of about 100,000 Tons of GAS COALS, during the Twelve months between the 1st of July, 1879, and the 1st of July, 1880, for use at their Works, situated respectively at Avon Street, St. Philip's, Canons Marsh, and Stapleton Road, Bristol.

Parties desiring to tender for these Coals can obtain specifications and full particulars as to delivery, &c., on application to the Secretary of the Company.

Sealed tenders to be addressed to the Chairman of Directors, Bristol United Gaslight Company, Canons Marsh, Bristol, marked "Tenders for Gas Coal," and delivered not later than Tuesday, the 3rd of June next.

HENRY H. TOWNSEND, Secretary.

Gaslight Offices, Bristol, May 9, 1879.

DEWSBURY CORPORATION GAS-WORKS, BATLEY CARR.

SALE OF SURPLUS PLANT.

TELESCOPIC Gasholder, 74 ft. in dia- meter, in Two Lifts, each 18 ft. deep, with Columns, Guides, Girders, Balance-Weights, &c.

Cast-Iron Tank, 76 ft. in diameter by 18 ft. 4 in. deep.

Two Cast-Iron Purifiers, 14 ft. 9 in. square, together with Covers, One 16 in. Dry Centre-Valve, Lifting Apparatus, &c.

Cast-Iron Pipe Condenser, 30 Columns of Pipes, 10 in. in diameter, Bottom Box 23 ft. long by 3 ft. by 1 ft. 6 in. deep.

Cast-Iron Annular Condenser, 12 Columns of Pipes, Outer Pipe 24 in. in diameter, Bottom Box 30 ft. 6 in. by 2 ft. 6 in. by 2 ft. deep.

Boiler, 11 ft. long by 4 ft. in diameter, Safety-Valve, Pressure-Gauge, &c. Ditto, 11 ft. long by 3 ft. in diameter, Safety-Valve, Steam-Gauge, &c.

Waggon Boiler, suitable for storeage of Tar.

The above will be sold by Auction on Tuesday, the 27th day of May next, at Eleven a.m. prompt.

CHAS. ARMITAGE, Engineer and Manager.

TENDERS FOR GAS COAL.

THE Corporation of Walsall invite TENDERS for the Supply of 24,000 tons of Staveley Yorkshire, or any other Good GAS COALS, to be delivered during One year from the 1st of July next, either at Walsall Railway Station, the Corporation siding at the new Gas-Works, or by boat at Walsall Old or New Gas-Works; in the latter case it will also have to be unloaded and stacked in the coal sheds, or at such other places at the Gas-Works as may be directed. The Coal will have to be delivered at the rate of from 100 to 850 tons per week, as the Corporation may from time to time require. Payments monthly.

The Corporation do not bind themselves to accept any tender, and they reserve the right to divide the contract between several firms.

Tenders, sealed and marked outside "Tender for Gas Coal," and stating the price for large Coal, and also for Nuts, are to be sent to the undersigned on or before Wednesday, the 28th inst.

SAMUEL WILKINSON, Town Clerk.

Bridge Street, Walsall, May 10, 1879.

THE Hampton Court Gas Company have FOR SALE, One 40 ft. by 16 ft. GASHOLDER, with six Cast Columns and Wrought Girders. To be Sold for £25, as the position is wanted.

Also the following PLANT, the whole of which is in excellent condition, having been removed for larger:—

One 8-horse Power Vertical Engine.
One 4-horse do. do.
One 15,000 feet Beale's Exhauster.
Two Beale's Slide-Valves for do.
Four Donkin's Valves.
Two Washers, with 8-in. Connections.

For further information, apply to Mr. E. PAGE, Engineer and Manager, Gas-Works, HAMPTON WICK.

MACCLESFIELD CORPORATION GAS-WORKS.

TO CONTRACTORS.

THE Gas Committee are prepared to receive TENDERS for the carrying out of the following Works, viz.:—

The conversion of a Gasholder-Tank into a Tar and Liquor Tank.

The Erection of Engine, Exhauster, Governor, and Pump Houses, and Extension of Retort-House.

The whole to be executed in accordance with plans and specifications, which can be seen, and bills of quantities obtained, at the Engineer's Office, Gas-Works, on and after the 20th inst., on payment of three guineas, which will be returned on receipt of *bona fide* tender.

Tenders addressed to the Chairman, Gas Committee, Town Hall, Macclesfield, to be sent in not later than Saturday, the 31st inst.

The Committee do not bind themselves to accept the lowest or any tender.

THOMAS MOORE, Engineer and Manager.

May 5, 1879.

BOROUGH OF BURY.

TO COLLIERY PROPRIETORS AND OTHERS.

THE Gas Committee of the Borough of Bury are prepared to receive TENDERS for GAS COAL and CANNEL for Two years, commencing the 1st of June next, to be delivered free at the Railway Siding, Buckley Wells, or at the Corporation Siding, Town's Yard, Fernhill, as may be required.

Estimated quantity about 23,000 tons of Coal and 9500 tons of Cannel.

Further particulars may be obtained upon application to Mr. Parsons, at the Gas-Works, Elton, near Bury.

Tenders, endorsed "Tender for Coal and Cannel," stating the colliery from whence the fuel is proposed to be supplied, to be sent to me, the undersigned, on or before Wednesday, the 28th inst.

The Company do not bind themselves to accept the lowest or any tender.

By order,
FREDK. BULL, Town Clerk.

Corporation Offices, Bury, May 12, 1879.

SUNDERLAND GAS WORKS.

SULPHATE OF AMMONIA WORKS.—CONTRACT FOR APPARATUS.

THE Directors of the Sunderland Gas Company are prepared to receive TENDERS for the Construction and Erection of certain Stills, Saturators, Tanks, Evaporators, and other Apparatus required for the Manufacture of Sulphate of Ammonia at the Hendon Station of their Gas-Works, together with certain cast and wrought iron materials connected therewith.

Drawings may be seen, and specifications and forms of tender may be had on application, at the Office of the Company, in Fawcett Street, Sunderland, and at the Office of Messrs. Thomas and Charles Hawksley, Civil Engineers, 30, Great George Street, Westminster, S.W., on and after Thursday, the 15th day of May inst., and tenders must be delivered at the Office of the Company, at or before Ten o'clock in the forenoon of Tuesday, the 3rd day of June next.

The Company do not bind themselves to accept the lowest or any tender.

By order,
J. H. COX, Secretary.

Sunderland, May 14, 1879.

WATFORD GAS AND COKE COMPANY.

GAS COAL.

THE Directors of the Watford Gas and Coke Company are prepared to receive TENDERS for the Supply of 3000 Tons of GAS COAL, to be delivered at the Bushey Station of the London and North-Western Railway, carriage free, between June 30, 1879, and June 30, 1880, in such quantities, and at such times, as the Directors may determine.

Parties tendering are requested to state the description of the Coal to be supplied, and to furnish an analysis showing the yield of Gas and Coke per ton of Coal, and the illuminating power of the Gas produced. The tenders may include the Gas Coal required by the Company for the years 1881 and 1882, each year ending on the 30th of June.

The Directors do not bind themselves to accept any tender.

Sealed tenders to be forwarded, addressed to the Secretary, 5, Derby Road, Watford, on or before May 31, 1879.

By order,
WILLIAM ROWELL, Secretary.

N.B.—The Directors pay the city dues.

LAMP REGULATORS,

(PADDON'S PATENT) FOR PUBLIC LIGHTING,

As adopted in the following and numerous other Districts at Home and Abroad:—

Accrington, Barnet, Birkenhead, Bradford, Brighton and Hove, Burslem, Bury, Carshalton, Croydon, Darlington, Dukinfield, Egremont, Gloucester, Harrogate, Hastings, Heckmondwike, Imperial (Hackney), Leeds, London (Nine Elms), Longton, Newent, Rayleigh, Reigate, Shipley, Southampton, Southgate and Colney Hatch, Southport, Sowerby Bridge, Stockton, Stoke, Torquay, Tottenham, Wakefield, Western (Notting Hill, &c.), Whitchurch, &c., &c.

These superior Dry Governors, or Street-Lamp Regulators, are substantially made and sensitive in action, carefully tested, and adjusted to any required consumption per hour. No mercury or glycerine required. No detached cone to corrode or set fast.

Reduced Prices. Liberal Terms.

THE IMPERIAL METER COMPANY, LIMITED,
(FORMERLY WALTER FORD, AT GRAY'S INN ROAD),
KING'S ROAD, ST. PANCRAS, LONDON, N.W.

PATENT

MACHINE-MADE RETORTS.

B. GIBBONS, JUN.,
STOURBRIDGE.

Price 28s., handsomely bound in Morocco, cloth sides, gilt edged and lettered.

THE FIRST VOLUME
OF
KING'S TREATISE
On the Science and Practice of the Manufacture and Distribution of
COAL GAS.

Edited by THOS. NEWBIGGING, C.E., M.Inst.C.E., and W. T. FEWTRELL, F.C.S.

Orders received by
WALTER KING, 11, Bolt Court, Fleet Street, London, E.C.

TO GASHOLDER MAKERS.

THE Sevenoaks Gas Company are prepared to receive TENDERS for the Erection, on their Works at Sevenoaks, of a Double-Lift GASHOLDER, 81 ft. in diameter and 40 ft. high.

Plans and specifications may be seen at the Company's Office, Sevenoaks, or at the Office of their Engineer, Mr. Alfred Penny, 20, Abingdon Street, Westminster, from whom may be obtained lithographed copies of the specification and conditions, price 5s.

At the same time the Directors will receive tenders for a 12-in. GOVERNOR of the best construction, with 12-in. Bye-pass Connections, fixed complete. Foundations will be prepared by Company.

Tenders to be sent in addressed to the Chairman of the Company, EDWYN CRONK, Esq., Sevenoaks, not later than the 28th inst.

May 12, 1879.

THE ACCRINGTON GAS AND WATER-WORKS COMPANY.

COAL CONTRACTS.

THE Directors of this Company invite TENDERS for the GAS COAL and CANNEL they may require during One, Two, or Three years from the 1st of July next, to be delivered free in trucks at the Railway Station, Accrington, at the Canal Wharf, Oakenshaw, and, if required, on their Siding, Great Harwood; in such quantities, and at such times, as the Directors or Secretary for the time being may require.

Sealed tenders, endorsed "Tender for Coal," and addressed to the Chairman, General Offices, Gas-Works, Accrington, to be sent in not later than 6 p.m. of Wednesday, the 4th of June.

Printed conditions of tender may be obtained on application to the Secretary of the Company.

The Directors do not bind themselves to accept the lowest or any tender.

By order,
CHARLES HARRISON, Secretary.

May 3, 1879.

BOROUGH OF BURNLEY.

TO COLLIERY PROPRIETORS AND OTHERS.

THE Corporation of Burnley are prepared to receive TENDERS for a Supply of Good GAS COAL, screened or unscreened, for a period of One, Two, or more years, from the 1st of July next, to be delivered into waggons at their Wharf on the Leeds and Liverpool Canal.

The quantity required will be 15,000 tons for the first year, and the Contractor must agree to supply any additional quantity required at the contract price.

Persons tendering must state the name of the mine, and guarantee the particular seam from which the Coal is to be supplied, as free as possible from sulphur, bats, bind, dirt, refuse, &c.

Further particulars may be obtained on application to Mr. S. P. Leather, Gas-Works Manager and Engineer.

Sealed tenders, endorsed "Tender for Coal," stating the price per ton, screened and unscreened, must be sent to the Chairman of the Gas Committee, 1, York Street, Burnley, not later than the 28th of May inst.

By order,
A. B. CREEKE, Town Clerk.

Corporation Offices, Burnley, May 9, 1879.

W. C. HOLMES & Co.,

ENGINEERS AND CONTRACTORS

FOR

GAS AND WATER-WORKS,

HUDDERSFIELD.

REFERENCES TO UPWARDS OF 400 WORKS.

WILSON CARTER AND PEARSON,

GAS COAL AND CANNEL FACTORS,

Supply to any Railway Station or for Export all kinds of Fuel for Gas purposes.

Address—CHIEF OFFICES:

TEMPLE BUILDINGS, 50, NEW STREET, BIRMINGHAM.

THE THAMES BANK IRON COMPANY,

(Successors to LYNCH WHITE,)

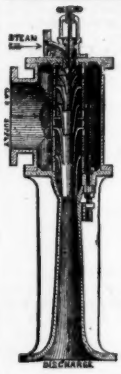
SUPPLY FROM STOCK

CAST-IRON RETORTS, SOCKET-PIPES for GAS or WATER PURPOSES, FLANGE-PIPES for STEAM, RAIN-WATER PIPES and GUTTERS, HOT-WATER PIPES and BOILERS, and all requisite Connexions for same; also LAMP-COLUMNS, LAMPS, WROUGHT FRAMES, WROUGHT-IRON TUBING, &c., &c.

All kinds of Gas-Works Apparatus and General Castings made to Pattern or Drawing.

ADDRESS—

OLD BARGE WHARF, UPPER GROUND STREET, LONDON, S.E.



KÖRTING'S STEAM-JET EXHAUSTER.

IMPROVED CLELAND'S PATENT.

UPWARDS OF 300 IN USE.

CLELAND'S SLOW-SPEED CONDENSER & STEAM SCRUBBER.

FOR PARTICULARS, APPLY TO

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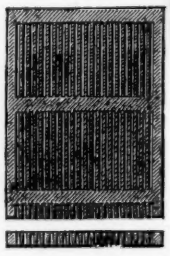
GERALD J. TUPP, Creek Engine-Works, Middle Mall, Hammersmith, London, W.

SOLE AGENT FOR ENGLAND AND WALES.

R. DEMPSTER AND SON'S



WOOD SIEVES FOR PURIFIERS,

WITH TAPER OR PARALLEL BARS,

MADE BY SPECIAL MACHINERY.

SCRUBBERS FILLED WITH BOARDS,

On our approved principle, for the extraction of Ammonia.

Prices on application. References to First-Class Engineers.

ROSE MOUNT IRON-WORKS,

ELLAND, NEAR HALIFAX.

LONDON OFFICES: 2, SUFFOLK LANE, CANNON STREET, E.C.

ECONOMY IN THE PRODUCTION OF GAS.

PLUTONIC CEMENT,

FOR JOINTING AND REPAIRING RETORTS AND OVENS *in* ACTION AND *out* OF ACTION.

A Pamphlet on the advantages of the above, with Modes of Application, References, Prices, &c., free by post, from the Sole Manufacturer,

WILLIAM RICHARDSON, Gas and Hydraulic Engineer, CHARLES HENRY STREET, and BISSELL STREET, BIRMINGHAM.

Now Ready, Price One Guinea,

PRECEDENTS IN PRIVATE BILL LEGISLATION

AFFECTING GAS AND WATER UNDERTAKINGS.

COMPILED BY MR. G. W. STEVENSON, C.E., F.G.S.

This Work contains information with regard to the practice of Parliament during the last fourteen years, in regard to most of the points on which differences arise in Opposed Bills for Gas and Water Undertakings, comprising—Authorized share and loan capital, Rates of dividend, Capitalization of profits, Term for the repayment of loans, Instances in which new shares are to be sold by auction and Exceptions to the Standing Order requiring new shares to be sold by auction, The limitation of back dividends, Illuminating power, Purity, Price, Notice before testing, The conditions under which the public supply of gas is regulated, Alteration of mains, Instances in which maps of mains are required, and All cases in which undertakings have been transferred, since 1845 in gas and 1865 in water, from Companies to Local Authorities.

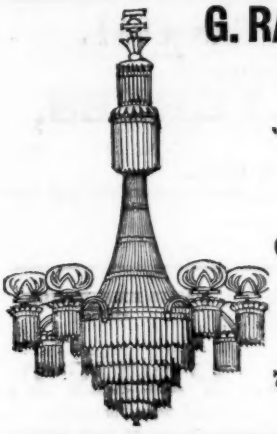
In the Water Precedents will be found, in addition, The rates for a supply for domestic purposes, and the Rates for other than domestic purposes.

LONDON: WALTER KING, 11, BOLT COURT, FLEET STREET, E.C.

COMMERCIAL GLASS WORKS, 27, WELLCLOSE SQUARE, LONDON, E.
CHEAPEST HOUSE IN THE TRADE
FOR
GAS GLASSES OF EVERY DESCRIPTION.

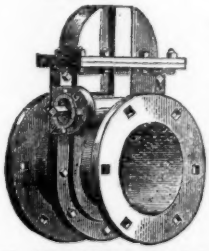
Opal 15-oz. Sheet Glass for Street-Lamps, 120s. for 200-ft. Case.

Write for Lists, free on application to any part of the World.



G. RAINSFORD & SON,
ESTABLISHED 1850,
MANUFACTURERS
OF
CHANDELIERS
AND
GAS-FITTINGS,
SUITABLE FOR
GAS COMPANIES.
70, BROAD STREET,
BIRMINGHAM.

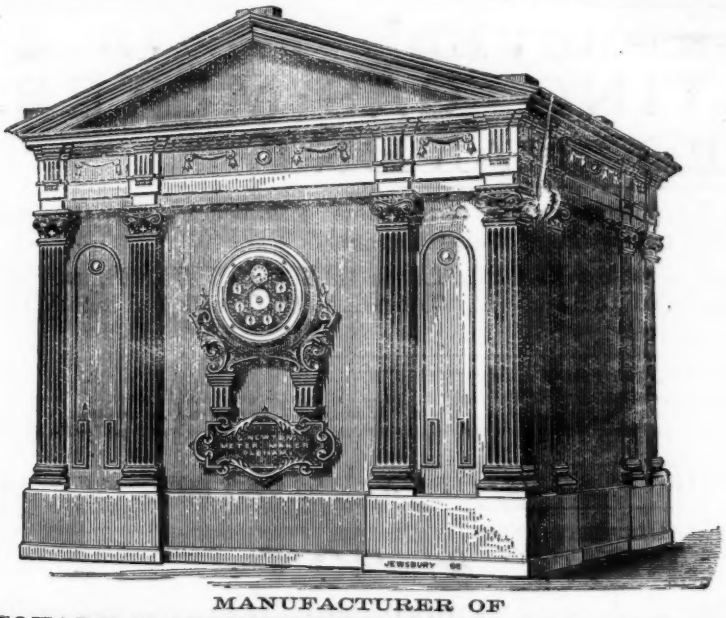
B. DONKIN & CO.'S
IMPROVED GAS-VALVES
WITH WROUGHT-IRON PINIONS.



List of prices, with full dimensions of all sizes up to 48-inch, to be had on application.
These Valves are proved on both sides to 30 lbs. on the square inch before leaving the works, and are kept in stock.
In ordering Valves, please state whether required for under or above ground, and if to be with flanges or spigots and sockets cast on, or with separate spigot and socket pieces.
ALSO SOLE MAKERS OF
J. BEALE'S NEW PATENT GAS EXHAUSTERS,
AND MAKERS OF
STEAM-ENGINES FOR DRIVING GAS EXHAUSTERS,
VALVES FOR AMMONIACAL LIQUOR,
IMPROVED BRIDGE VALVES FOR REGULATING THE SEAL IN HYDRAULIC MAINS,
BYE-PASS VALVES, SCREW WATER-VALVES, &c.

B. DONKIN & CO., 55a BLUE ANCHOR ROAD, BERMONDSEY, LONDON, S.E.

GEORGE NEWTON,
UNION STREET WEST, OLDHAM,



MANUFACTURER OF
SQUARE STATION-METERS, with PLANED JOINTS;
ROUND STATION-METERS, WITH CAST-IRON STANDS;
WET AND DRY CONSUMERS GAS-METERS, GOVERNORS, &c.

SWANWICK CANNEL.
Illuminating power, 34 candles. Good Coke, 11½ cwt. to the ton.
For analysis, prices, and references, apply to
H. BOAM, Litchurch Villa, DERBY.

WANTED, by Samuel Thompson & Co., Colliery Office, Lancaster, APPLICATION for PRICES from Gas Managers who are prepared to receive Tenders for GAS COAL or CANNEL.
John Leigh, Esq., M.R.C.S., F.C.S., &c., &c., in his analytical report of S. T. & Co.'s Coal, says: "It is remarkable for its purity, I have scarcely ever examined a Coal containing so small a quantity of ash, and when Cannel of the best description is scarce, it may well replace this material."

SULPHATE OF AMMONIA APPARATUS.
I am now prepared to Erect Plant or Supply Plans of this New and Efficient System for Making Sulphate of Ammonia. For terms, &c., address as below. I have constructed a small apparatus (glass) which shows the principle and illustrates the working of the larger plant admirably. I guarantee this apparatus to give a first-class result in sulphate if worked according to my instructions, &c. Price of small apparatus, c.o.d., £1 1s.
Address JOHN G. HARVEY, 31, Old Georges Street, CORK.

E. & W. H. HALEY,
IRONFOUNDERS & MAKERS OF
CAST-IRON PIPES
FOR
GAS, WATER, & STEAM.
LISTER HILLS FOUNDRY,
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The Dunston Engine Works Co.,
GATESHEAD-UPON-TYNE.
Are the Sole Manufacturers of
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ALSO OF
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(As supplied to Sir Wm. Geo. Armstrong, C.B.),
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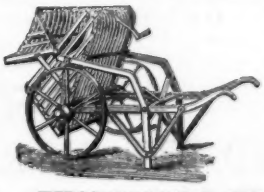
Archer's Patent Ore Crusher & Pulveriser,
Unequalled for the purposes of Mine Owners, Chemical Manufacturers, Cement Manufacturers, and others.

TO MAKERS OF SULPHATE OF AMMONIA AND BUYERS OR SELLERS OF GAS LIQUOR.
F. SUTTON & CO., Norwich, are now prepared to Supply a Set of Apparatus with Standard Test Solutions for the rapid and accurate analysis of Gas Liquor, which can be used by any intelligent workman, so as to show the actual amount of Sulphate which can be got out of any sample of liquor in a few minutes, without any of the annoyance arising from saturation with acid, &c. Tables are also given, showing the quantity of acid of various strengths required for any given liquor, the accurate ounce-strength and percentage of pure ammonia, &c. Price of the set, with full direction and table (copyright), with materials sufficient for fifty analyses, £4 4s.
Post orders or cheques to be made payable to F. SUTTON AND CO., Manufacturing Chemists, NORWICH, who also supply every description of Standard Solutions for Volumetric Analysis of Waters, Beers, Manures, &c., of guaranteed accuracy.

TO ENGINEERS & MANAGERS.
CLIFTON'S PATENT BARROW



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For particulars apply to the Sole Makers,
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THE WIGAN COAL & IRON COMPANY,

LIMITED,

DISTRICT OFFICE: 97, NEW STREET, BIRMINGHAM; AGENT: W. M'GOWAN,

Supply the Best Wigan Arley Mine Gas Coal, Gas Nuts, Gas Cannel, &c.

N.B.—The Wigan Coal and Iron Company, Limited, are exclusive owners of the well-known HAIGH HALL AND KIRKLESS HALL GAS COAL COLLIERIES.

GAS COAL. GAS COAL. GAS COAL.

WELLS, BIRCH, RYDE, and CO., Limited,

HOYLAND SILKSTONE COLLIERIES,

Near BARNSLEY.

This Company is now in a position to raise **2000 tons per day of REAL OLD SILKSTONE GAS COAL.**

"The quality of this Coal for Gas purposes, if equalled, is not excelled by any on record, and the Coke competes successfully with best Durham."—See *Mining Journal*, Aug. 11, 1877.

Prices quoted to any Railway Station, or F.O.B. Hull, Grimsby, Goole, Keadby, Liverpool, and Fleetwood.

Full particulars will be sent on application to above address.

HONOURABLE MENTION. **J. E. WILLIAMS & CO.,** PARIS EXHIBITION, 1878.

SOLE MANUFACTURERS OF THE

SPECIAL METALLIC OXIDE PAINT,

Largely used by Gas Companies, Corporations, Railway Companies, Ironfounders, and Machinists. It has the following qualifications and properties:—

EFFECTUALLY PREVENTS AND ARRESTS CORROSION.
HAS A FINE GLOSS, AND IS VERY DURABLE.
DOES NOT REQUIRE DRIERS LIKE OTHER PAINTS.
PROTECTS IRON FROM ACTION OF WATER.

IS NOT AFFECTED BY SULPHURETTED HYDROGEN.
FORMS A VERY HARD TOUGH (NOT BRITTLE) SURFACE.
WILL NOT CRACK, BLISTER, OR SCALE.
IS NOT AFFECTED BY EXTREMES OF TEMPERATURE.

COVERS NEARLY DOUBLE THE AREA OF OTHER PAINTS.
(7 gallons or 1 cwt. will cover 1211 square yards of Ironwork.)
IS CHEAPER AND MORE ECONOMICAL THAN ANY OTHER.

VICTORIA PAINT WORKS, COLLYHURST, MANCHESTER.

1862.

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HALLETT'S
PATENT ANTIMONY PAINT.

MADE ONLY BY

GEORGE HALLETT & CO.,

296, ROTHERHITHE, LONDON, S.E.

Price 30s. per Cwt. Special Driers supplied at same Price.

This light stone-coloured Paint, for which a Prize Medal was obtained in 1862, is free from certain defects of white lead. It does not produce any deleterious effect upon the health of those who use it, such as painter's colic, nor is it blackened by sulphur compounds in the atmosphere; while, from its less specific gravity and good body, it covers more surface, weight for weight, and, therefore, it is preferable and more economical than white lead.

It is peculiarly adapted for Gas-Works.

IMPROVED
COMPENSATING GAS-METER.
HUNT'S PATENT.

This Meter supplies a want long felt, by putting an end to the loss sustained by Gas Companies through the overworking of their Meters.

These Meters can now be supplied in either TIN-PLATE or CAST-IRON CASES, and OLD METERS converted to this plan. GAS COMPANIES and CORPORATIONS will find it to THEIR ADVANTAGE to adopt these Meters.

EXTRACTS FROM REPORTS.

"I am able to report that the Meters have given in each test most satisfactory results."—*Mr. H. Sporne, City of London Meter Inspector.*

"I consider the arrangement is a great improvement upon the Meters in present general use."—*Mr. T. Jackson, Meter Inspector, Birmingham.*

"I would observe from the results of my testings that the Meters are a great improvement on the ordinary Wet Meters in general use."—*Mr. H. Airey, Meter Inspector to the Metropolitan Board of Works.*

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MANUFACTURED BY

JOHN BENT & SON,

WET AND DRY GAS-METER AND GAS APPARATUS MANUFACTURERS,

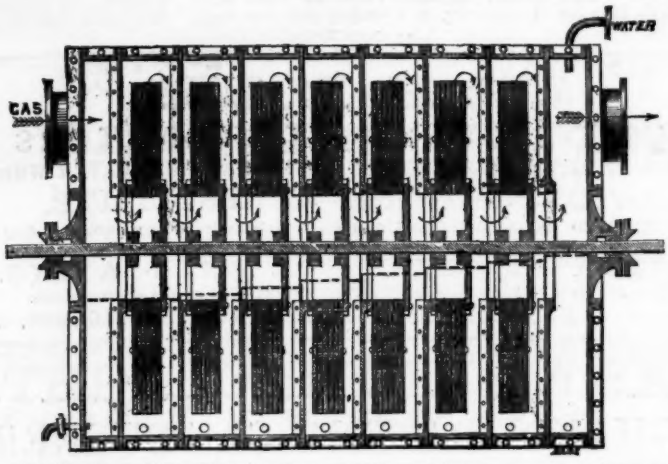
BELL BARN ROAD, BIRMINGHAM.

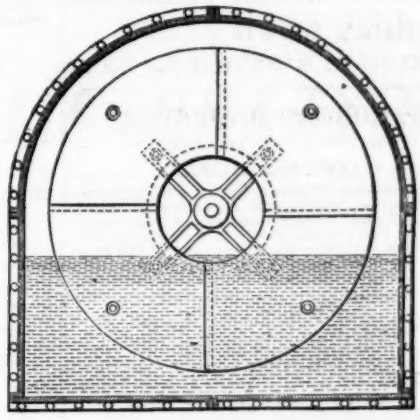
Established 1830.

THE

"STANDARD" WASHER & SCRUBBER.

[KIRKHAM, HULETT, AND CHANDLER'S PATENT.]





This Washer and Scrubber has been used for nearly two years on a large scale at the Works of The Gaslight and Coke Company, Bromley-by-Bow, at which station there are now several in operation and in course of construction. There is also one in use at the Pancras Station, King's Cross, of the same Company, which is purifying 1,500,000 cubic feet of gas per day. At the Gas-Works of the Corporation of Leeds, a large one has been erected, which is giving complete satisfaction. The Special Merits of this Washer are as follows:—

That it is a very effective Condenser, so that it is not absolutely necessary to reduce the temperature of the gas to 60°, or thereabouts, to make the Washer effective.

That the distribution of the liquor is made with unerring regularity.

That it occupies very small space, so that it can be, at little expense, effectually protected from extreme changes of the weather.

That the considerable expense of Coke or Wood, or other Scrubbing Material, is entirely saved, and that the great nuisance and cost of from time to time replacing the Scrubbing Material is avoided.

That, by the revolution of the discs, the quantity of water carried up by them, and tending continuously to fall, exposes a very large amount of fresh wetted surface to contact with the gas.

That it is particularly adapted for Gas-Works where Sulphate of Ammonia is manufactured.

That it is much cheaper than any other Scrubber that will do the same amount of work effectually.

That it is the only Washer suitable for purifying Gas from all its impurities by solution.

That it works with a minimum of pressure.

That it takes out every trace of Ammonia from the Gas in once traversing the machine.

That it requires very little outlay for foundations.

The following Testimonials show the opinion of eminent Engineers as to the capabilities of the Washer:—

(Copy.)

The Gaslight and Coke Company
Bromley-by-Bow, May 3, 1877.

D. HULETT, Esq.

Dear Sir,—In answer to your inquiries respecting the results of the working of your Patent Washer, I beg to state that I find it a very efficient machine. I have had it in operation for some time, and passed gas through it continuously at the rate of 100,000 cubic feet per hour, and obtained from it 11 gallons of 10 oz. liquor per ton of coal carbonized—results which appear to me very satisfactory for so small a Washer. It works very smoothly, taking but little power, and giving no pressure. I have it still in operation, and am perfectly satisfied with its working.

I am, dear Sir, yours truly, (Signed) W. B. WRIGHT.

(Copy.)

The Leeds Corporation Gas-Works,
York Street, Leeds, Dec. 6, 1878.

Messrs. KIRKHAM, HULETT, and CHANDLER.

Gentlemen,—The Scrubber-Washer erected by you at these works, and which has been in use for six months, has proved to be, so far as we have been able to test it, thoroughly efficient. We are at present making 32,000 feet of gas per hour, and are entirely dependent on this apparatus for the removal of Ammonia, and the **Gas is perfectly free from that impurity in the sixth chamber**, so that four chambers remain to deal with an increasing make of gas. Owing to insufficient condensers, the gas was in the summer admitted to the Scrubber at a temperature of 70°, but was reduced therein to 61°, or that of the atmosphere. The volutes are driven at the rate of four revolutions per minute, and, working at that speed, there is not the slightest difference between the inlet and the outlet pressure. Clean water supplied at the rate of 10 gallons per ton of coal carbonized is converted into liquor of from 10 oz. to 13 oz. strength **in once traversing the vessel.** The apparatus is extremely simple and compact, occupies but little space, and requires no foundation. I shall be surprised if it does not eventually become extremely popular.

I am, Gentlemen, yours faithfully, (Signed) HENRY WOODALL, Engineer.

(Copy.)

The Gaslight and Coke Company.
York Road, King's Cross, Jan. 14, 1879.

Messrs. KIRKHAM, HULETT, and CHANDLER.

Gentlemen,—In reply to your inqutry, I am pleased to say, the Washer which was put in action at this station in October last has quite fulfilled my expectations, as it confirms the experiments I made in May last with the smaller machine. Working at four revolutions per minute, **it takes out every particle of Ammonia**, while purifying more Gas than it was intended to do. I enclose particulars of a fortnight's working during our heaviest make, by which you will see that it yields the full quantity and strength of liquor, and works with little pressure. I am therefore quite satisfied with the machine, and trust it may meet with the success it deserves.

I remain, Gentlemen, yours truly, (Signed) JOHN CLARK.

The following Table shows the results of the working of one of these Washers, lately erected to purify 60,000 feet of Gas per Hour, at the St. Pancras Station of The Gaslight and Coke Company:—

1879.	Nos. of the Divisions and Strength of Liquor in each.										Water used per Ton of Coals.	Gas Purified per Hour, Cubic Feet.	Ammonia on Outlet.	Temperature.			Pressures.		Revolutions per Minute.
	1	2	3	4	5	6	7	8	9	10				Inlet.	Outlet.	Atmo-spheres.	Inlet, Inches.	Outlet, Inches.	
	oz.	oz.	oz.	oz.	oz.	oz.	oz.	oz.	oz.	oz.									
January 1	8½	6¾	5	3½	2½	1½	⅝	¼	0	0	10 Gallons.	52,000	Nil.	77°	73°	48°	24	23	7½
,, 2	8¾	7	6	4½	3½	2½	1½	⅝	¼	0	10 ,,	57,000	Nil.	73°	66°	32°	21½	20½	4
,, 3	9½	8	6	3⅝	3	2½	1⅛	⅜	⅛	0	10 ,,	60,000	Nil.	75°	68°	40°	23½	22	4
,, 4	9½	7¾	6½	4¼	3½	2½	1⅝	⅜	⅛	0	10 ,,	65,000	Nil.	74°	68°	33°	24	22½	5
,, 5	9½	7	6	4	3	2⅛	1¼	½	⅛	0	10 ,,	34,000	Nil.	77°	68°	35°	14¼	14	5
,, 6	9¼	7¼	6½	4¼	3	2¼	1½	1	¼	0	10 ,,	63,000	Nil.	72°	66°	27°	24	22½	4½
,, 7	11	9	7	5½	3½	3	1⅝	1½	⅛	0	10 ,,	59,000	Nil.	74°	66°	31°	25	23½	5
,, 8	9½	7½	6	4½	3	2	1	¼	⅛	0	10 ,,	78,000	Nil.	73°	61°	31°	28	26½	4½
,, 9	11	9	7	5	3½	2½	1½	1	⅛	0	10 ,,	82,000	Nil.	74°	67°	33°	27½	25½	5
,, 10	10½	8½	6½	5	3½	2½	1½	1	⅛	0	10 ,,	66,000	Nil.	76°	64°	28°	28½	27	5
,, 11	12½	10	7½	5½	4½	3½	1⅝	1¼	⅛	0	10 ,,	61,000	Nil.	78°	64°	27°	26½	25½	5
,, 12	11	8½	6½	—	—	—	1¼	⅜	⅛	0	10 ,,	39,000	Nil.	74°	64°	27°	26½	25½	5
,, 13	13	10½	8½	6	4½	3½	2	1½	⅛	0	10 ,,	78,000	Nil.	73°	65°	42°	28	26	5

(Signed) JOHN CLARK, Engineer.

WASHER-SCRUBBERS OF THIS PATENT ARE IN COURSE OF CONSTRUCTION FOR BECKTON, BRADFORD, GREENWICH, WOOLWICH, AND SEVERAL OTHER GAS-WORKS.

For further particulars and testimonials, address

Messrs. KIRKHAM & HERSEY, GAS ENGINEERS, 21, ABINGDON STREET, WESTMINSTER.

HENRY LYON (14 years Engineer and Manager of the largest of the Manchester Corporation Gas-Works) Mechanical and Consulting Gas Engineer, reports upon the condition and value of Gas-Works, supplies plans and specifications of all Apparatus appertaining to Gas-Works, and re-models existing Works.
Address Brooklyn, near Halliwell Lane, Cheetham Hill Road, MANCHESTER.

W. LIDDALL,
Public Accountant,
MOORGATE STREET CHAMBERS,
GREAT SWAN ALLEY,
MOORGATE STREET, E.C.

Mr. ROBERT DEMPSTER,
CONSULTING GAS ENGINEER,
ELLAND, near HALIFAX,
May be consulted on all matters connected with Valuations, Arbitrations, and Parliamentary Applications connected with Gas-Works. Having been engaged on extensive Arbitration Cases, which, combined with his experience in Construction and Contracting, his knowledge of Engineering and Valuations is both extensive and reliable.

Established 1799.
ROBERTSONS & CO.,
TWEED IRON-WORKS,
BERWICK-UPON-TWEED.
Makers of Socket, Flange, and Hot-Water Pipes, Tank-Plates, Lamp-Posts, Columns, Girders, and Gas and other Castings.

WILLIAM HAILES,
Builder and Contractor
FOR THE ERECTION AND RESETTING OF RETORT-BENCHES,

Fire Goods and Iron Work Supplied.

Hailes's Improved Retort Settings guaranteed to produce the greatest amount of heat with a small per cent. of Fuel.

Plans and Specifications Prepared.

Address: 122, Westfield Street, St. Helen's, Lancashire, and 3, High Street, Brentford, Middlesex.

CADZOW COAL COMPANY,
LIMITED.
Cadzow Collieries, Hamilton (Lanarkshire).
Office: 161, Hope Street, Glasgow.

Report on the Cadzow Ell Coal.
By Dr. W. WALLACE, F.R.S.E., F.C.S., Gas Examiner for the City of Glasgow.

I have made a careful chemical analysis and practical assay of an average sample of the Ell Coal from Cadzow Colliery, received on the 5th inst., from Messrs. The Cadzow Coal Company, Hamilton, and have obtained the following results:—

Analysis.

Volatile matters	Gas, tar, &c.	34·03	
	Sulphur	·04	46·12
	Water, at 212° Fahr.	12·05	
Coke	Fixed carbon	52·90	
	Sulphur	·03	53·88
	Ash	·95	
			100·00

Coke (dry) per ton of Coal, 1205 lbs., or 10 cwts. 3 qrs. 1 lb

Analysis of the Coke (Dry).

Carbonaceous or combustible matter	98·18
Sulphur	·06
Ash	1·76
	100·00
Specific gravity of the coal	1·250
Weight of a cubic foot in pounds	77¾

Practical Results.

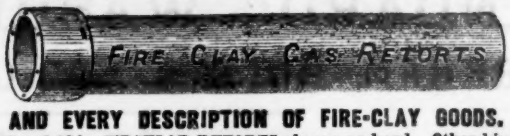
Gas per ton of coal at 60° F. and 30 in. bar.	10,122 cub. ft.
Illuminating power in standard sperm candles by Argand jet, consuming 5 cubic feet per hour	16·76 candles.
Value of one cubic foot of gas in grains of sperm	402
Equivalent of a ton of coal in pounds of sperm candles	581
Durability of one cubic foot of gas by 5-inch flame	42 min. 45 sec.
Gravity of the gas, air = 1000	448

Remarks.

The sample tested consisted of a complete section of the seam, 5 ft. 6 in. in thickness. The results show that this Coal is well adapted for the manufacture of gas and coke, both being for soft coal of very fine quality. Of the many hundreds of coal samples I have tested, I have not hitherto had one with so small a proportion of ash as the Cadzow Coal.

Chemical and Gas Laboratory, WILLIAM WALLACE.
138, Bath Street, Glasgow, March 15, 1878.

JOHN HALL AND CO., STOURBRIDGE,
Manufacturers of FIRE-BRICKS, LUMPS, TILES,

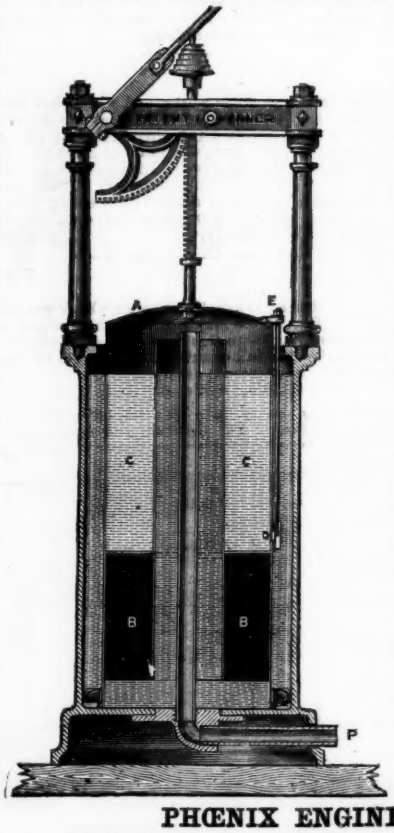


AND EVERY DESCRIPTION OF FIRE-CLAY GOODS.
N.B.—A Stock of 15 and 16 in. CIRCULAR RETORTS always on hand. Other kinds made to order on short Notice.

J. & H. ROBUS,
BUILDERS AND CONTRACTORS
FOR THE ERECTION AND REBUILDING OF GAS AND WATER WORKS,
RETORT-SETTING—A SPÉCIALITÉ.
ROBUS'S IMPROVED RETORT-SETTINGS, guaranteed to Carbonize a large amount of Coal with a small per cent. of Fuel.
ESTIMATES GIVEN FOR MAIN-LAYING.
N.B.—All kinds of Fire Goods and Gas Apparatus supplied on the shortest notice.
Address:—J. & H. ROBUS, BELL GREEN, CATFORD, LONDON, S.E.

GAS *v.* ELECTRIC LIGHT.
WIGHAM'S PATENT GAS-BURNERS
FOR
STREET LIGHTING, &c.
Speaking of these burners, erected on the Thames Embankment by Westminster Bridge, the *Daily News* says:
". . . . A blaze of light is thrown out, which, in point of efficiency and brilliancy, far surpasses the large gas-lamps lately erected in Waterloo Place, *while even the electric lights are quite thrown into the shade.*"
SOLE MANUFACTURERS:
J. EDMUNDSON & CO., GAS ENGINEERS,
19, GREAT GEORGE STREET, WESTMINSTER, LONDON, S.W.

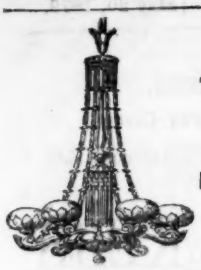
GEORGE WALLER & CO.,
GAS AND HYDRAULIC ENGINEERS,
Patent Compensating Steam Governor,
WITH SELF-CONTAINED WATER-BALANCE.



DESCRIPTION OF THE APPARATUS.
The illustration represents a section of the Patent Governor. The lower part of the Bell A is fitted with a loose Float B, and in the upper part of the Bell is a deep annular Water Chamber C, at the bottom of which is an opening D, with a slide outside regulated by a Screw Spindle E, to allow the water to pass in and out of the Chamber C quickly or slowly, according to circumstances, but when once adjusted the slide does **not require altering.** This Self-compensating Chamber gives great steadiness to the up and down movement of the Bell and effectively prevents the "hunting" motion so common with other Governors, thereby ensuring a more perfect action on the throttle-valve of the Engine **than attained by any other.** The sketch shows the clip lever fixed to work on throttle-valve at an angle, and can work in either direction. P is the Gas Inlet-pipe to Governor.

G. W. & Co. also make **special Steam Throttle Valves,** suitable for working with this Governor, and alter existing Throttle Valves to same plan.

PHŒNIX ENGINEERING WORKS,
Holland Street and Bear Gardens, Southwark, S.E.



F. & C. OSLER,

45, OXFORD STREET, LONDON, W.

MANUFACTORY AND SHOW-ROOMS:

BROAD STREET, BIRMINGHAM.

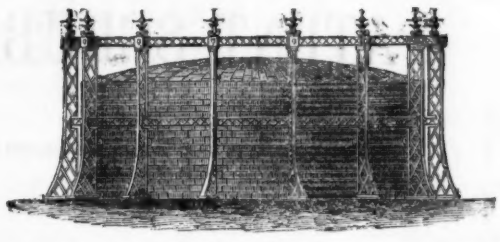
ESTABLISHED 1807.

MANUFACTURERS OF CRYSTAL GLASS CHANDELIERS.

WALL LIGHTS, AND LUSTRES FOR GAS AND CANDLES.

TABLE GLASS OF ALL KINDS.

CHANDELIERS IN BRONZE AND ORMOLU. MODERATOR LAMPS.



THE HORSELEY COMPANY,

LIMITED,

TIPTON, STAFFORDSHIRE.

LONDON OFFICE:

6, WESTMINSTER CHAMBERS, VICTORIA STREET,

GAS ENGINEERS, IRONFOUNDERS, &c.,

MANUFACTURERS OF

GASHOLDERS, WROUGHT AND CAST IRON TANKS, CONDENSERS, PURIFIERS, SCRUBBERS, MAINS, RETORT-LIDS, PLAIN AND DISHED LAMP-POSTS, PIPES,

AND ALL REQUISITES FOR EITHER

GAS OR WATER WORKS;

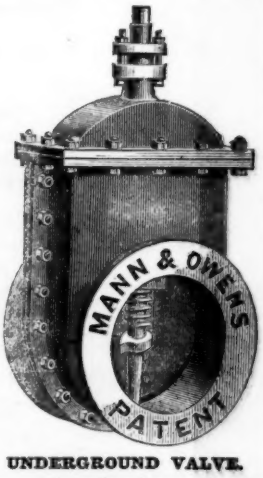
ALSO

MAKERS OF ROOFS, BRIDGES, &c.

MANN & OWENS' PATENT GAS-VALVE.

VALVE, with Indicator for Above Ground.

EVERY VALVE WARRANTED TO BE PERFECTLY SOUND AND GAS-TIGHT.



UNDERGROUND VALVE.

The advantages of this Patent Valve over all others yet introduced are, that it is always as tight as the best wedge or spring valve, without the possibility of setting fast or becoming suddenly leaky. The surfaces not being in contact during the operation of opening or closing, leakage through wear and tear is avoided.

The Gas Engineer will not fail to see the importance of such a valve in connexion with his purifying apparatus, particularly in the case of large sizes.

The slide being operated either by a screw and nut, or by a pinion and rack, a cam bearing upon a plane, cast on the back of the Valve, forces it against the face, and renders the escape of gas an impossibility. By a slight turn of the pinion or screw, the slide is released, and brought away from the face, by which means friction is avoided, and the only force required to open the Valve is that due to its own weight.

SOLE MANUFACTURERS:

S. OWENS AND CO.,

HYDRAULIC AND GENERAL ENGINEERS,

WHITEFRIARS STREET, LONDON, E.C.

PRICES, SIZES, AND FULL PARTICULARS ON APPLICATION.

T. NEWBIGGING,

CONSULTING GAS ENGINEER,

5, NORFOLK STREET, MANCHESTER.

ALFRED LASS, F.I.Accts.,

SPECIAL ACCOUNTANT FOR GAS AND WATER UNDERTAKINGS,

30, GRACECHURCH STREET, LONDON.

Accounts Analysed and Statistics Prepared for Parliamentary Proceedings, Arbitrations, &c.

The Forms of Account, which have been specially designed by Mr. Lass to meet the requirements of the Gas-Works Clauses Amendment Act, 1871, are now in use by many Gas Companies, Corporations, and Local Boards.

THOMAS CARR & SON,

MANUFACTURERS OF

FIRE-BRICKS, LUMPS, TILES, RETORTS, &c.,

COTSWOOD FIRE-BRICK WORKS, SCOTSWOOD-ON-TYNE.

Also Makers of all kinds of Common Building Bricks, and of Pressed White and Red Bricks for Facing.

BIRTLEY IRON WORKS,

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DURHAM.

Manufactory for every description of Casting and Machinery for Gas-Works and Water-Works.

Warehouse in London for Cast-Iron Pipes and Connexions of all sizes and in any quantity, Scott's Wharf, Bankside, Southwark.

Agent in London, Mr. J. Manwaring, 101 Cannon Street, E.C.

JAMES OAKES & CO.,

ALFRETON IRON-WORKS, DERBYSHIRE,

AND

WENLOCK IRON WHARF, 21 & 22, WHARF ROAD, CITY ROAD, LONDON, N.,

Keep in London and at their works large stocks of PIPES and CONNEXIONS (1¼ to 36 inches in diameter); also make and supply Retorts, Tanks, Columns, Girders, Special Castings required by Gas, Water, Railway, Telegraph, Chemical, Colliery, and other Companies.

CHARLES HORSLEY, Agent.

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SILICA FIRE-BRICK CO.,

OUGHTIBRIDGE

Near SHEFFIELD,

Manufacturers of THE ORIGINAL SILICA OR DINAS FIRE-BRICKS. Specially adapted for Gas-Retort Furnaces and for Siemens's Gas-Furnaces. Shipments promptly executed to London, Liverpool, Hull, Grimsby, &c.

TROTTER, HAINES, & CORBETT,

BRETTELL'S ESTATE

FIRE CLAY & BRICK WORKS,

STOURBRIDGE.

Manufacturers of GAS-RETORTS, GLASS-HOUSE FURNACE & BLAST-FURNACE BRICKS LUMPS, TILES, and every description of FIRE-BRICK.

Proprietors of

BEST GLASS-HOUSE POT and CRUCIBLE CLAYS.

Successors to

E. BAKER AND CO., LATE BRIERLEY HILL, STAFFORDSHIRE.

HARPER & MOORES,

PROPRIETORS OF THE

BEST STOURBRIDGE CLAYS,

STOURBRIDGE.

Manufacturers of all Descriptions of

BEST STOURBRIDGE FIRE-BRICKS, LUMPS AND CLAY RETORTS

Of all Dimensions for Gas-Works,

GLASS-HOUSE POTS & CRUCIBLES

ESTABLISHED 1836.

The Highest Award was obtained by H. & M., at the Philadelphia Exhibition, 1876, for Superior Quality of Manufacture. SILVER MEDAL, PARIS, 1878.

GAS AND WATER PIPES.

WILLIAM MacLEOD & CO.,

30, ST. ENOCH SQUARE, GLASGOW.

CAST-IRON GAS AND WATER PIPES.

DELIVERY F.O.B., GLASGOW

Prices on application.

C. & W. WALKER,
8, FINSBURY CIRCUS,
LONDON, E.C.

MANN & WALKERS' PATENT SCRUBBER.

By Letters Patent in Great Britain, Europe, and the United States of America.

By some important improvements recently patented, the purifying power of these Scrubbers has been much increased, and a stronger ammoniacal solution obtained, which is found to absorb a large portion of the carbonic acid contained in gas, effecting an important saving in money and labour in the lime purifiers, and where oxide only is used, the increase in the illuminating power of the gas obtained by these Scrubbers is shown in a remarkable degree, in consequence of the large quantity of carbonic acid removed from the gas.

It is to be particularly noted that the im- portant results of these Scrubbers do not depend upon the machinery alone. The entire internal construction of the Scrubber bears an almost equally important part. For this reason, where it is desirable to convert existing Scrubbers, whose dimensions happen to be suitable, the work commences by ripping out the whole of the interior of the shell, and beginning the internal construction *de novo* from bottom to top.

Fifty million cubic feet of gas per 24 hours are purified from ammonia by these Patent Scrubbers in a winter's day in the gas-works of London, where the purity of gas supply is the highest in the world, under the chemical restrictions of the Board of Trade.

Generally, wherever a high standard of purification is maintained in the chief cities and towns of the British Provinces and of Europe, these Scrubbers have become established.

By their use the department of purification from ammonia upon a gas-works is made complete, without the aid of prepared oxide of iron, chemicals in purifiers, or any other supplementary process, and the whole ammoniacal residual product contained in the coal is absorbed and obtained in the form most profitable to a gas company, while the requirements of all Acts of Parliament and of the Board of Trade, relating to incorporate gas companies, are satisfied.

Foul Gas, properly condensed, entering the inlet is, by once only passing through the Scrubber, completely purified from ammonia with regular certainty day by day, without any further trouble, or any other process, effected by a very small quantity of clear water let into the machinery room at the top of the Scrubber, which is discharged at the liquor outlet at the bottom, from Newcastle coal at about 18 to 20 ounces strength, from Yorkshire and other coals generally from 25 to 30 ounces strength; while acidulated litmus or turmeric exposed at the Scrubber outlet will not show the slightest discoloration, and there is not a quarter of a grain of ammonia per 100 feet left unabsorbed.

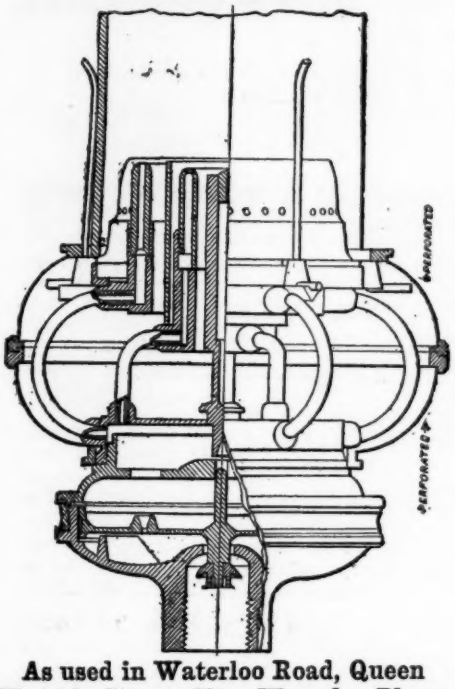
They contain their own engine power, re- quiring only a small inappreciable quantity of steam from the gas-works boiler, and are then complete in themselves, ready for service.

Applications relating to dimensions and prices should be addressed to us, C. AND W. WALKER, 8, FINSBURY CIRCUS, LONDON, E.C., or to Mr. WILLIAM MANN, late Superintendent of the Chartered Gas-Works, BLACKFRIARS, LONDON; they should state approximately the largest make of gas in 24 hours or a winter's day, and the smallest make on a summer's day, to be purified.

WILLIAM SUGG'S
IMPROVED SYSTEM OF STREET LIGHTING,

SUITABLE FOR EITHER CANNEL OR COMMON GAS.

SECTIONAL ELEVATION
of 80-candle Burner

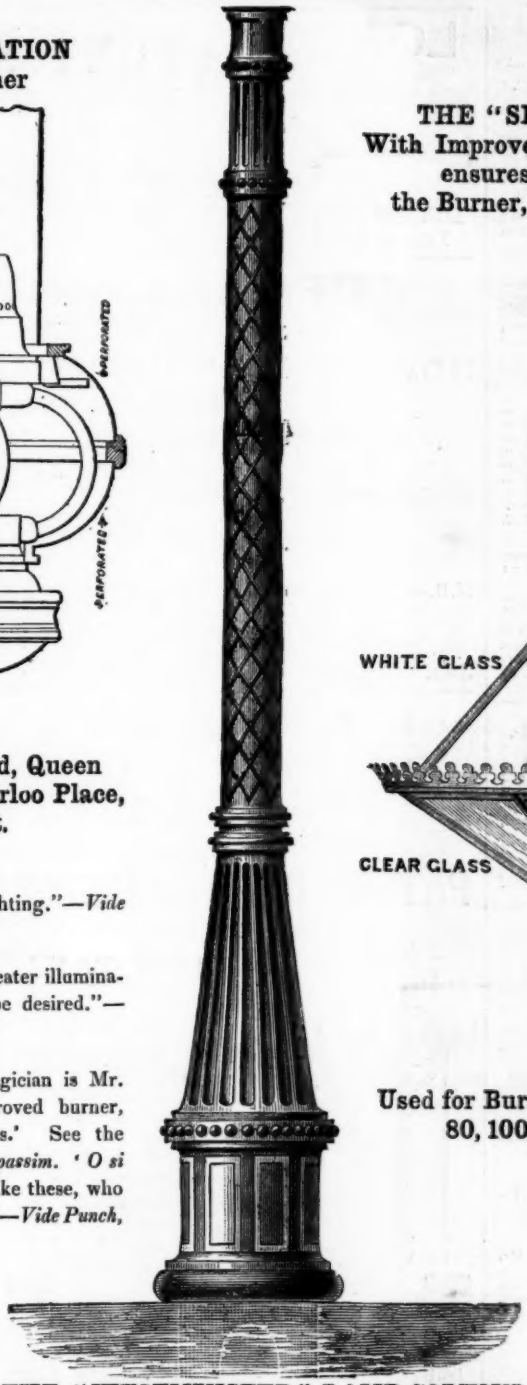


As used in Waterloo Road, Queen Victoria Street, City, Waterloo Place, and Regent Street.

"The perfection of street gas lighting."—*Vide* "*Times*," *Feb.* 1, 1879.

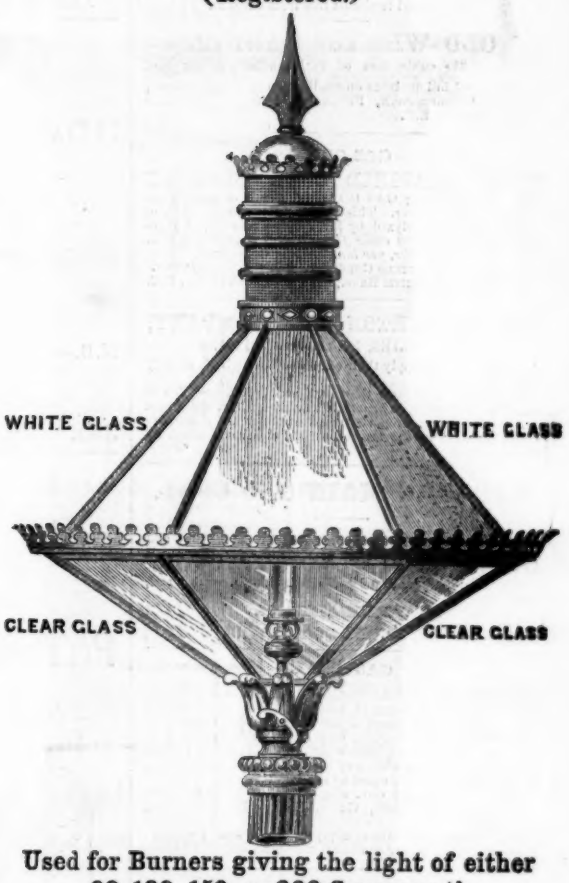
"For all practical purposes no greater illumination than is hereby supplied could be desired."—*Vide* "*Daily News*," *Jan.* 13, 1879.

"The real modern Aladdin's magician is Mr. Sugg, who, by means of his improved burner, gives us 'new lamps for old ones.' See the Waterloo Road and Waterloo Place *passim*. '*O si sic omnia!*' If all gas light were like these, who would ask for Edison and electricity?"—*Vide Punch*, *Feb.* 15, 1879.



THE "WESTMINSTER" LAMP-COLUMN,
Of Improved construction,
8 feet and 9 feet from ground to top of Column.

THE "SHADOWLESS" LANTERN,
With Improved System of Ventilation, which ensures steadiness of the flame of the Burner, even in very windy weather.
(Registered.)



Used for Burners giving the light of either 80, 100, 150, or 200 Spermaceti Candles.

Other Patterns of Lanterns and Columns are in course of construction, and will be shortly Published in this JOURNAL.

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Yields 14,920 cubic feet of 40·92-candle gas per ton.

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12,880 cubic feet of 40·32-candle gas per ton, and 9 cwts. of good coke.

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Yields 12,500 cubic feet of 34-candle gas per ton, and 9 cwts. of excellent coke, containing only 4 per cent. of ash.

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Yields 13,160 cubic feet of 32·5-candle gas per ton, and 10 cwts. of excellent coke, containing only 5 per cent. of ash. This cannel is almost free from sulphur.

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Yields 13,320 cubic feet of 32·5-candle gas per ton.

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This Coal is now highly approved of for gas making, and yields over 10,000 feet per ton of 15-candle gas, and about 14 cwt. coke.

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One ton yields 12½ cwt. of good coke. This Coal can be shipped from Hull, Goole, Liverpool, Morecambe, and Barrow.

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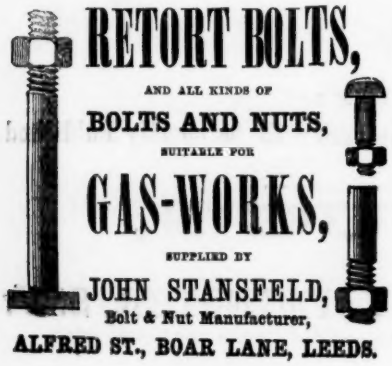

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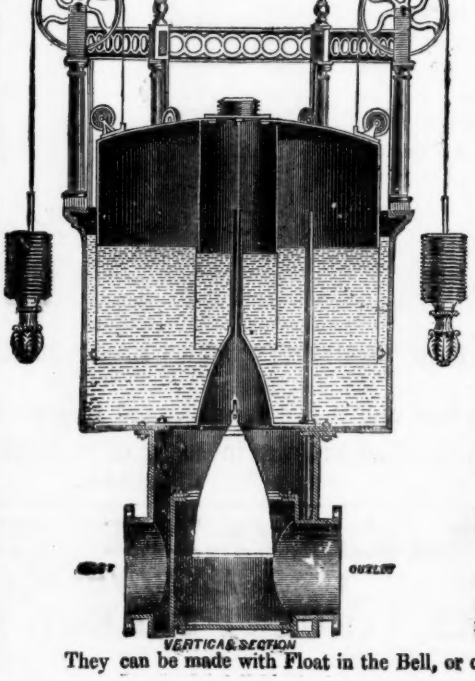
PATENT COMPENSATING GAS GOVERNOR,

Which is designed to give an uniform pressure at the Outlet to the Main at all draughts up to the full quantities which the Governors are made to control, such outlet pressure being less than the initial pressure.



VERTICAL SECTION

The uniformity of pressure is obtained by introducing a compensating chamber into the Bell or Holder of the Governor, which compensator is of the same area as the valve, both of which are operated on by the initial pressure, thereby placing the valve in equilibrium, no matter what the initial pressure may be. The action on the Bell is by the Gas passing along a pipe from the outlet, and the pressure is regulated by weights in connexion with the Bell as required.

From the sectional elevation attached hereto, it will be seen that only the Gas required to operate the Bell comes in contact with the water of the tank, which water will remain comparatively sweet and free from odour. That in case of accident to the Bell, no more Gas can escape than would pass up the pipe covering the valve-rod and Bell supply-pipe.

These Governors have been made and sent out of various sizes for from 2 to 24-inch Mains, and give most satisfactory results.

They can be made with Float in the Bell, or counterpoise as per section.

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JAMES PATERSON Esq., Gas Engineer, of the Warrington Gas Company, reported, Aug. 10, 1875:—

"This Coal possesses remarkable qualities as a gas and coking coal, and appears SECOND TO NONE IN THE KINGDOM. It contains the large quantity of 699 lbs. of illuminating matter, and 1498 lbs. of coke to the ton, and produces **12,240** cubic feet of 16·66 candle gas."

The above Company are raising nearly a thousand tons of the Real Old Silkstone Gas Coal per working day.

PRICES QUOTED TO ANY RAILWAY STATION, OR F.O.B. HULL, GRIMSBY, GOOLE, KEADBY, LIVERPOOL, AND FLEETWOOD.

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PLANT ERECTED ON THE LATEST AND MOST APPROVED PRINCIPLE.

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PARIS EXHIBITION, 1878.

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JOSEPH CLIFF & SONS
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SILVER MEDAL
FOR THEIR
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RETORTS AND FIRE-BRICKS,
Being the Highest Honour given for this class.

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A recent extensive development of the Collieries enables us to offer increased supplies.

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"Warrington Gaslight and Coke Company,
Offices, Mersey Street, Warrington, April 23, 1877.

"MESSRS. NEWTON, CHAMBERS, AND CO.,

"GENTLEMEN,—After carefully testing the various samples of Gas Coals sent from your Collieries for analysis, I have pleasure in reporting them as belonging to the highest class of Gas and Coking Coals.

"The average of Nine samples gives a yield of **12,500** cubic feet of **15½**-Candle Gas, being equivalent to **664** lbs. of sperm per ton, and **1420** lbs. of fixed carbon of a very superior quality. All the samples bear a close relation to each other in value.

"Yours truly, "JAMES PATERSON."

Full particulars will be sent on application to us—address as above.

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THE "RELIANCE,"

MANUFACTURED BY THE

GAS-METER COMPANY, LIMITED

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The object attained by this invention is the *correct measurement of Gas under every fluctuation of the pressure.*

Accuracy is obtained by subjecting the whole of the water which determines the measuring chambers of the drum to one uniform even pressure, and so prevents unequal displacements of the water-line.

The "RELIANCE" METER has been tested by several of the most experienced official meter inspectors. Copies of their reports may be obtained on application to the

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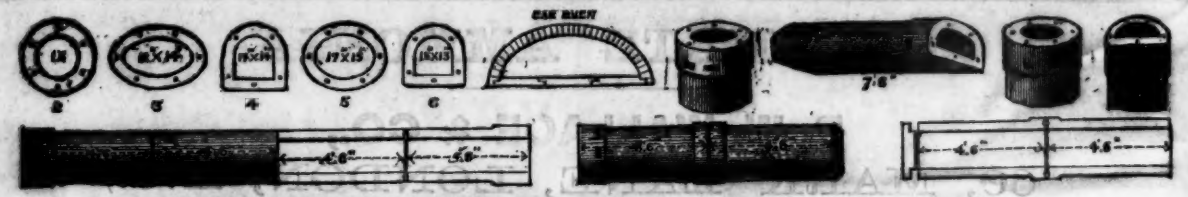

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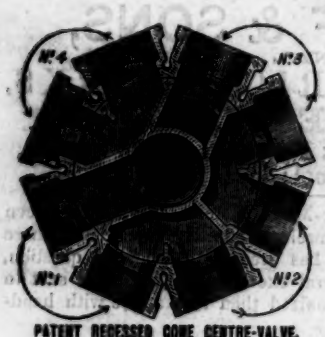
Constructed on the principle of the ordinary Plug-Cock.

THROUGH-WAY & FOUR-WAY COCKS

Of all descriptions.



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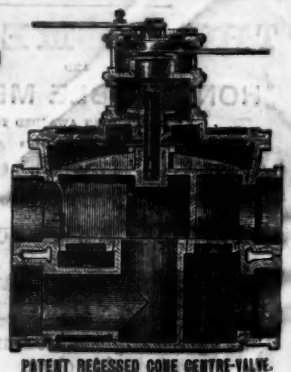
Sectional Plan.



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